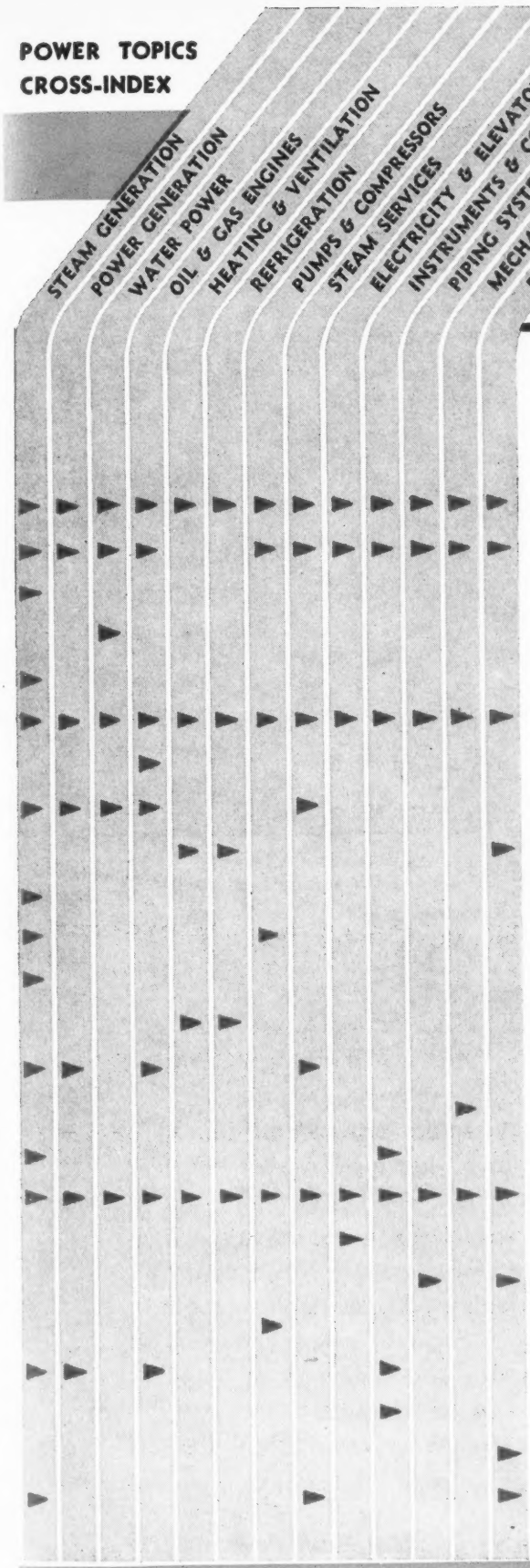

Volume 79 Number 13

POWER

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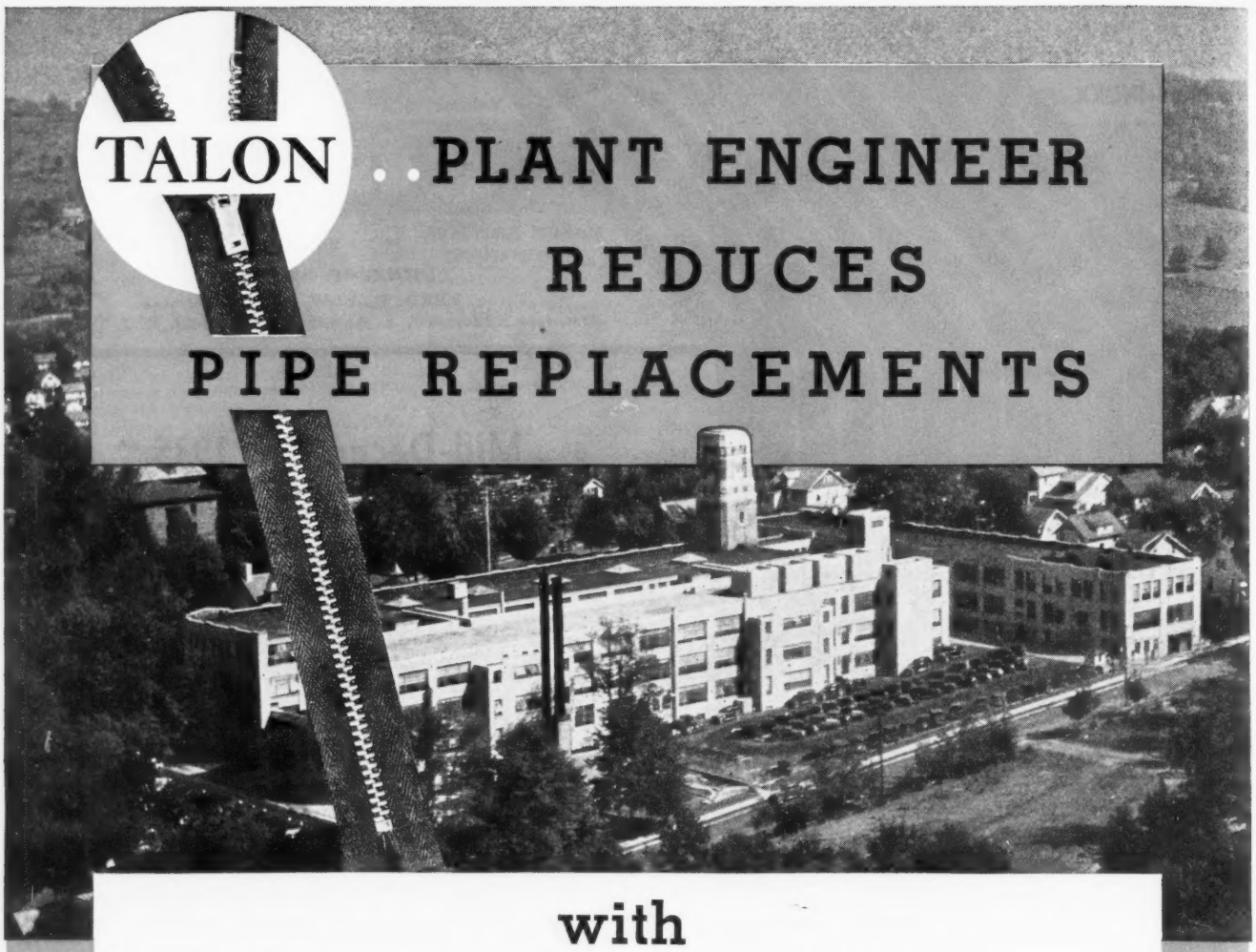

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POWER

A McGraw-Hill Publication—Established 1884
PHILIP W. SWAIN, *Editor*

● LIFE in America moves at a terrific pace. Obviously, we are going somewhere fast; it behooves us to consider where—to consult the road map as well as the speedometer.

This speeding up of our national life has been in process longer than any of us can remember. Consider writing, for example: goose quill, steel pen, fountain pen, typewriter, automatic typewriter. Or transportation: foot, horse, stage, canal boat, sailing ship, steamship, railway, automobile, airplane.

No use trying to complete this listing; we have all heard the story of the industrial revolution. Not as fully appreciated is the acceleration of this pace during the last fifteen years. Autos, planes, looms and machine tools were commonplace in 1920, but think how much faster they run today.

If we could stop long enough to look, we would see that the world of 1935 is not merely *moving* faster, but *changing* faster, than ever before—changing in those externals the public sees and in every hidden process of mine, factory and office.

Nor has the depression halted this advance. These six lean years are not to be subtracted from the fifteen years of progress since 1920. On the contrary, if capacity to produce is wealth (and if that capacity includes the blueprints and "know how" of better machines and methods) we can properly say that America has accumulated more wealth in the last six years than in any other equal period of her history.

The wealth we have stored is not be to measured in gold or paper dollars, but in our capacity to produce kilowatts, r.p.m., ton-miles and miles per minute, and to convert these into food, clothing, houses, and luxuries in endless profusion.

Because this is a civilization based on motion, and because the engineer alone can produce and direct motion, he finds himself today at the center of things. Thus far, he has kept pace with his own creations, but he faces five, ten, twenty years of further acceleration.

As a group, engineers can and will meet the demand for even greater speeds in communication, transportation and production, by tuning up their mental machinery to carry the load. Some, as individuals, will do this superbly, and thus create for themselves the envied positions of indispensable men. Others will imagine that the engineering knowledge and methods of 1935, or even of 1920, will be salable in 1940. They, too, may find their niche, but only as men of a bygone age, horse-and-buggy experts whose craftsmanship seems worthy of some minor application.

Our word to the engineer everywhere is this: Train yourself to know widely, understand profoundly, adjust rapidly for an age when power and automatic devices will control all except the men who can master them.

Turn this page and see for yourself how far we have traveled in power alone since 1920. Then consider where this undeniable momentum of events must carry all of us in another five or ten years.

15 YEARS...

By PHILIP W. SWAIN
Editor of POWER

In power plants, as in most other things, America has moved far since the good old days of 1920

IT IS 1920. Less than two years ago, bugles throughout the world have sounded "taps" over the "war to end war." The League of Nations is born. After decades of agitation by suffragists (militant and otherwise), women win the right to vote. Main Street throughout the land echoes the reverberations of a bomb that does $2,000,000 damage on Wall Street. Less notice by far is paid to the earthquake that snuffs out 200,000 Chinese lives in Kansu province.

Prohibition is a few months old and the bootlegger begins to find his way around. Only last year Alcock and Brown made the first non-stop transatlantic plane flight. Model A Ford lies eight long years over the horizon of the future. Ford buyers have to take a Model T and like it. Many do both.

Tinpan Alley is peddling "Sheik of Araby." All the young ladies of the day rate the young men as sheiks or non-sheiks.

Strikes, like a plague of gnats, pester American industry. Newspaper cartoons picture fat coal barons, in plug hats and frock coats, clutching John Public by the throat. Power-plant owners and operators stay awake nights worrying about coal shortages and embargoes and fall asleep dreaming of hydro as the only way out.

James Watt, dead 101 years, lives on in the engines and turbines with an installed capacity of 10,500,000 kw. in central stations and a practically equal amount in industrial and building plants.

This, in high light, is the picture of America a mere 15 years ago, back in 1920. It is a picture I shall amplify from the power angle and compare with the power scene of 1935. For I propose to show how far we have moved in this short time, placing side by side for your inspection some of the outstanding performances of the two years. But I hope to do it with an easy touch, to edify rather than instruct, to flavor this hard-boiled Mid-December reference number with a dash of armchair reminiscence.

I have selected the 15-year period for comparison because it is a round number, because it includes practically the whole of our post-War progress, and because it approximates the term of my own connection with *Power*.

In reporting events I shall not split hairs on dates. Doings and records reported for 1920 or 1935 may actually have occurred the year before. The difference is of no consequence to my present purpose, which is to recreate an industrial drama, rather than set down a few dry facts.

In those days of 1920, as is true today, the combined steam-generating capacity of industry and buildings far exceeded that of all the central stations combined. Then, as today, process and building heat was the more indispensable function of the industrial power-service plant, with electrical and mechanical power generation optional.

Reviewing the year, *Power* of 1920 looked ahead. The writer of the January review pictured great opportunities in the direction of higher steam pressures. At no distant date, he said, "the present maximum of 350 lb. and 650 deg. should be exceeded."

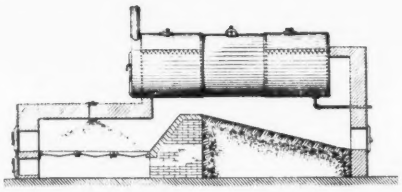
Post-war scarcity of coal and labor had intensified the development of fuel- and labor-saving equipment in boiler-room and engine-room. Operators were beginning to make frequent use of automatic control of damper, air supply, stoker engines and feedwater. England was talking of even higher pressures and temperatures. I. E. Robinson claimed that 500 lb. and 700 deg. were just around the corner. He noted attempts to save low-grade heat by bleeder heating of feedwater, and by reheating steam after partial expansion. But reheating he felt, held little promise.

Springdale Station was installing four 15,000-sq.ft. boilers, each with two 13-retort underfeed stokers and clinker grinders, designed to operate at ratings of 250% and up. Kansas City boasted of the size of its new chain-grate stokers, 10 ft. wide and 17½ ft. long, and also of its economizer combining steel tubes in the high-pressure section with cast-iron in the low.

Those days initiated the great expansion of public generation and distribution—the hooking up of steam and hydro stations into systems and of systems into super-systems.

Looking to the near future, John A. Stevens proposed that super-power stations be built in multiples of 30,000-kw. sections, up to a total station capacity of 100,000, 300,000, "or even 500,000 kw." (Today Hudson Avenue is 750,000 kw.) He advocated moderate preheating of combustion air by bleed steam. He wanted telephones provided at all important points in the station. He suggested periscopes to read water level.

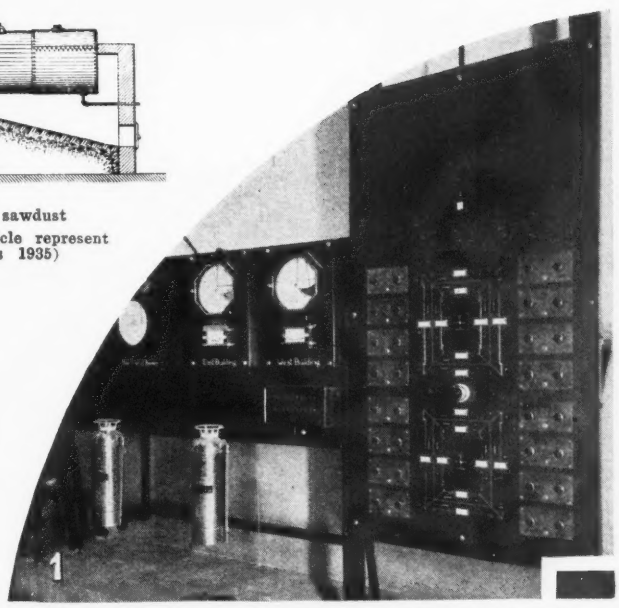
Now for contrast, let's look at a few power-plant high spots reported in 1935 (which means completed in either 1934 or 1935). The Port Washington (Wis.) station goes into operation with one 80,000-kw.

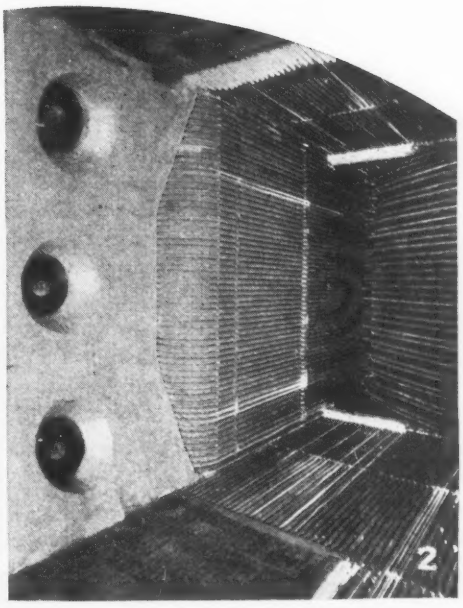


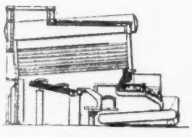
Burning hog fuel and sawdust

(All sketches in this article represent 1920 practice, photos 1935)

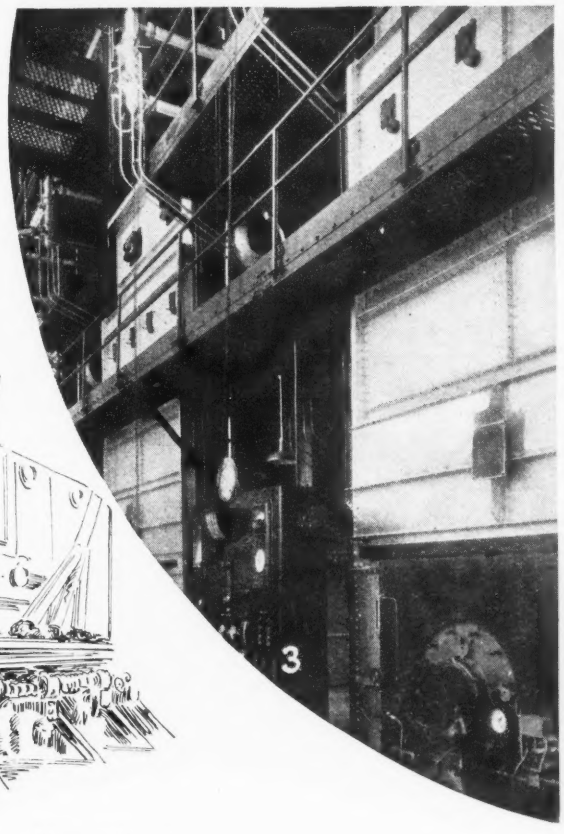
SHOTS OF 1935: 1, Brain of a heating system; 2, Looking up in a furnace; 3, Industrial boiler room; 4, Normandie brings 160,000 kw. from France

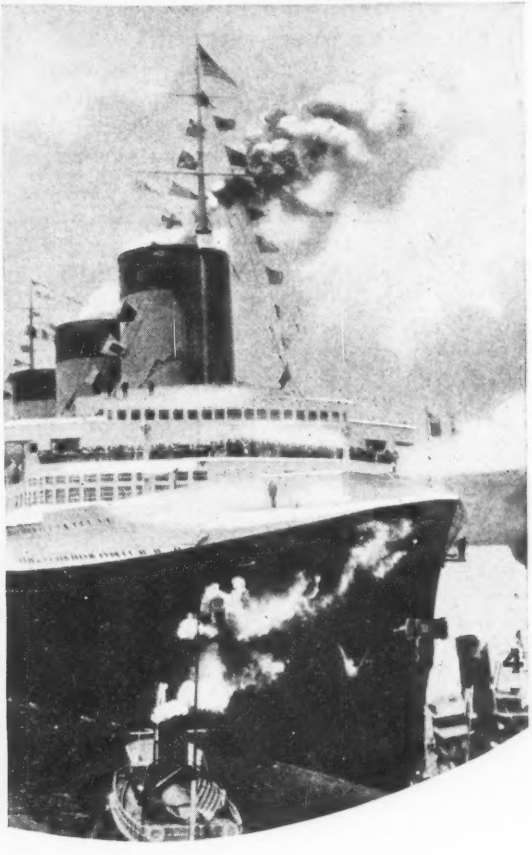


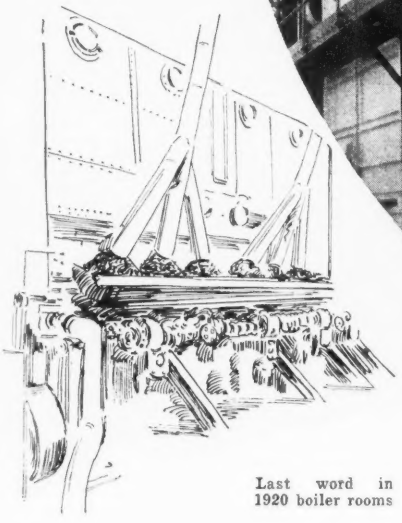




Chain-grate stoker installation







Last word in 1920 boiler rooms

turbine. Its single boiler, generating 690,000 lb. of steam per hour at 1,320 lb. pressure and 850 deg., has 70-ton solid-forged drums 40 in. in diameter, $5\frac{1}{4}$ in. thick and 52 ft. long. The over-all height of the unit is 92 ft. Pulverized coal is fired through 20 burners shooting downward.

In the industrial field, Ford, Firestone, Goodyear and West Virginia Pulp & Paper install big high-pressure units. Ford starts installing a "two-decker" 110,000-kw. turbine and a boiler of 800,000 lb.-per-hour capacity at 1,400 lb. and 900 deg. F. Fired by pulverized coal, this boiler unit includes economizers and air heaters.

This astonishing installation might be expected of Henry Ford, but Firestone, too, installs a 1,400-lb. boiler, supplying a 10,000-kw. back-pressure turbine exhausting to evaporators which in turn serve process-heat loads. Boiler drums are 4 in. thick, welded, X-

rayed and stress-relieved. Furnace is water-walled, with slag bottom. Boiler-heating surface is reinforced by an enormous air preheater.

Ford's big 110,000-kw. unit, 66 ft. long, has a guaranteed water rate ranging from 8.9 to 8.3 lb. The boiler has 1,796 tubes and burns three fuels simultaneously—blast furnace gas, coke-oven gas and powdered coal. Guaranteed efficiency averages 87% from half to full load.

Goodyear Tire & Rubber generates at 800 lb. and 750 deg. The turbine bleeds 150,000 lb. of steam per hour at 200 lb. pressure for use by the old turbine. Again we find the air preheaters, water-walled slag-bottom furnace, pulverized-fuel firing.

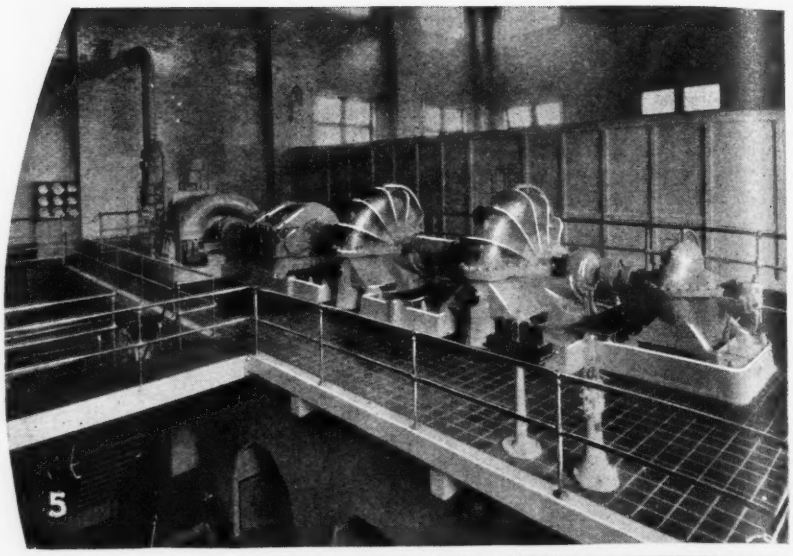
In 1921, when the first Ford plant was installed, it was announced that "the boilers will operate at 250% of rating, although 400% is possible." Some of today's central stations exceed 1,000% rating. Back in 1920 the A.S.M.E. Boiler Code did not permit fusion welding where the weld carried the load. Today, welded boiler drums are commonplace; their safety has been demonstrated, thanks largely to the caution of the Code Committee in insisting upon elaborate testing, X-ray inspection and complete over-all stress-relieving of welded drums.

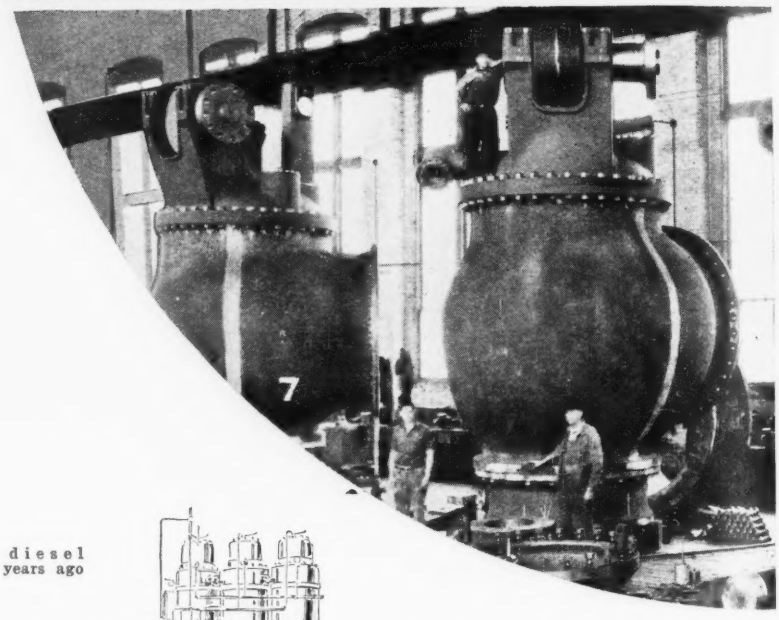
Even the small plants show wonderful changes from the old days. Take Clinton (S.C.) Cotton Mills, for example. The furnace is completely water-cooled. Pulverized coal is fired from the side. Gas meanders through the tubes in a horizontal plane, instead of up and down. The back row of tubes nearest the burner is faced with refractory plastered on steel studs. Efficiency, without economizer or air heater, holds above 82% over a wide load range.

In Europe, over a number of years, strange new boilers have been developed along lines entirely distinct from American practice. The Benson steam generator turns water into steam, without boiling, at the critical point (3,200 lb. pressure and 706 deg.) Sulzer Bros. pump feedwater through a single boiler tube more than a mile long. Not to be outdone by the Benson scheme of making steam without boiling, Loeffler comes along with a steam generator that boils water without any fire, using pumped superheated steam instead.

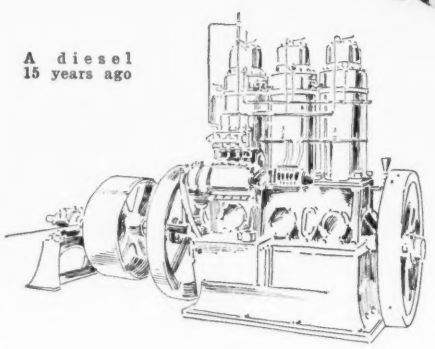
I almost forgot to mention the most sensational of all, the Velox steam generator, which bears about as much relation to the orthodox boiler as the duck-billed platypus in the zoo bears to a household tabbycat. Features are 40-lb. furnace pressure, water moving faster than sound, outside steam separation and a gas turbine operated by the flue gas. Here we have the boiler plant turned into a machine. And it's no joke; Europe has nearly twenty installations.

In 1920 began one of those business dramas of which America has seen so many. Underfeed and traveling-grate stokers had become standard for mechanical firing. The stoker business was booming. Then pulverized coal, long a mere curiosity, became suddenly

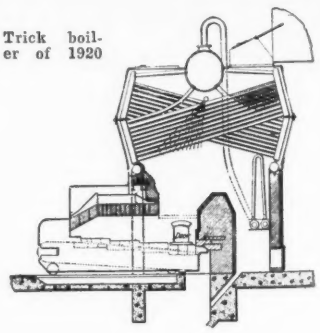


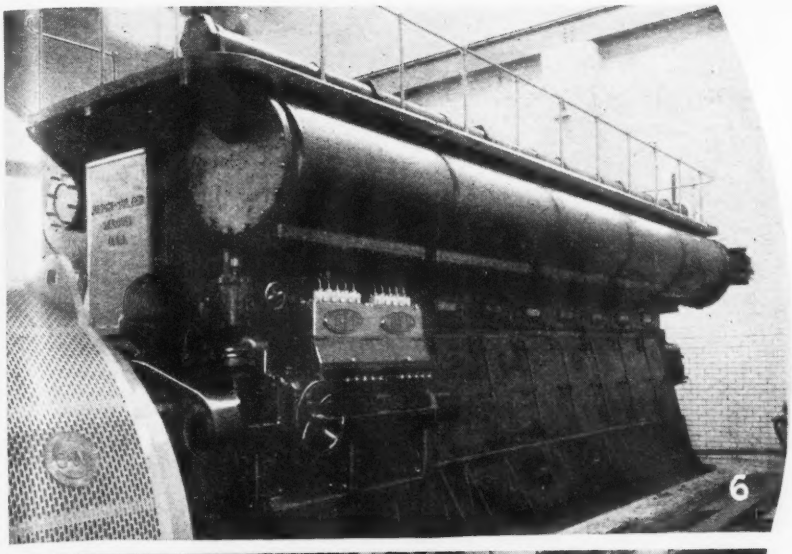


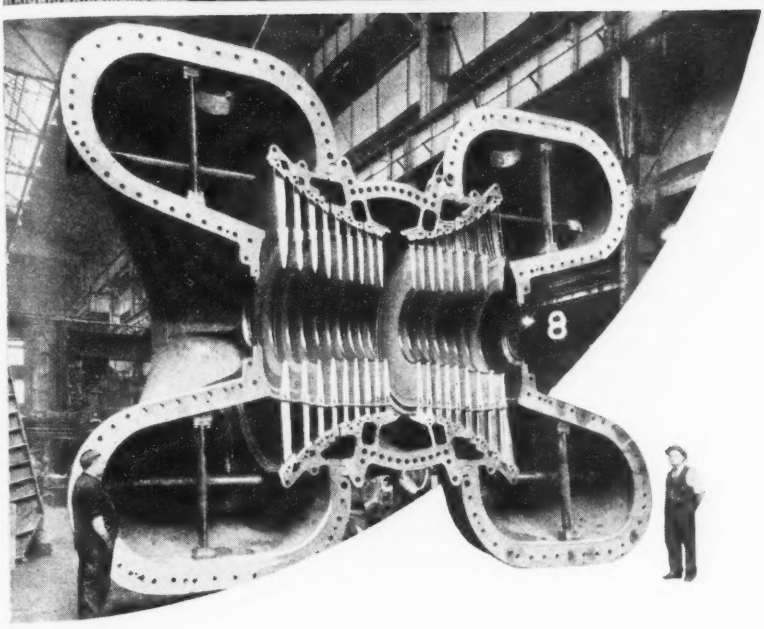
A diesel 15 years ago



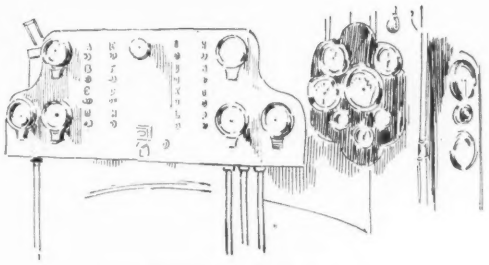
Trick boiler of 1920







SHOTS of 1935: 5, Pumps geared down from turbine; 6, Diesel for packing house; 7, Energy absorber for Boulder Dam; 8, Low-pressure casing top for Ford's 110,000-kw. turbine



Last word in gage boards—1926

down, and the stoker folks were able to point to a saving in coal preparation cost and the avoidance of the fly-ash nuisance. From that day to this the competition has been keen, and the question "which is best, pulverized fuel or stokers?" is no closer to an answer than it was in 1920. A classic example of rapid progress through competition of two great competing arts!

In steam turbines the notable event of the 1920 era was the starting up of the 3-element, cross-compound, I.R.T. (New York) turbine, with a 2-hour capacity of 70,000 kw.—60,000 kw. normal. "Most powerful prime mover in the world."

Turbines then were not as reliable as now, and builders were studying data on accidents to a number of large machines. They must have found the answer, because today one rarely hears of turbine explosions.

Active cooperation between utility and equipment manufacturer explains much of the remarkable power progress made during this 15-year period. And utilities, spared the handicap of competition, shared their findings to the limit. One would act as a laboratory for this; another for that. A few years back, for example, Detroit Edison was willing to step far ahead of commercial practice, and try out 1,000-deg. steam in a 10,000-kw. turbine.

Compare with the 3-cyl. 60,000-kw. I.R.T. turbine of 1920, the 165,000-kw. unit recently installed in the Richmond station in Philadelphia. And remember that this has a single rotor, not three. If you count 3-cyl. units, you must credit Today with 207,000 kw. (State Line).

Back in 1920, large turbines never ran faster than 1,800 r.p.m. In 1935 several 3,600-r.p.m. machines were built for capacities as high as 10,000 kw.

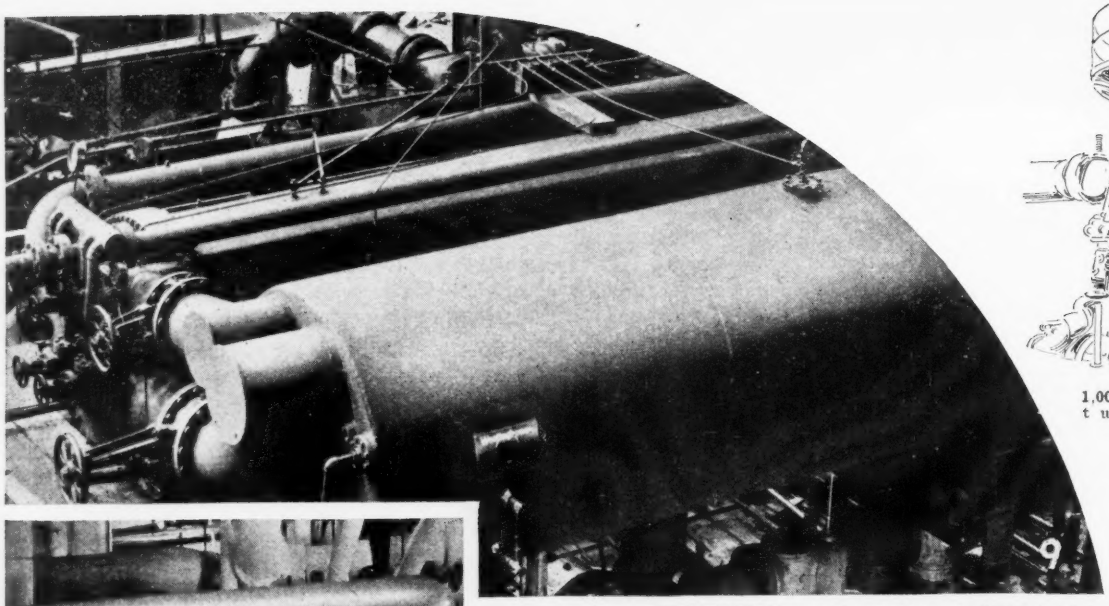
Condensers have grown with turbines, but not as fast. One kilowatt of turbine now takes 0.7 sq.ft. of condenser instead of 1.3.

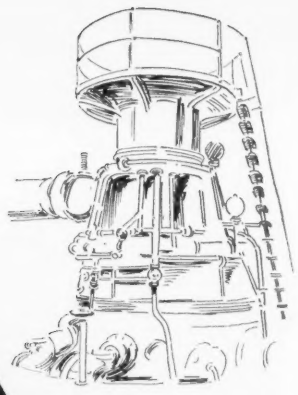
important. Except for the usual beginner's troubles John Anderson's Milwaukee installations were a success, and word began to flash around that pulverized coal would replace the stoker. Advantages claimed were load flexibility, simpler operation, no clinkers, no stoker breakdowns, ease of handling ash, higher efficiency in routine operation.

But the stoker manufacturers did not take this lying down. They immediately studied and redesigned their own product. Stoker flexibility, capacity and efficiency went up, breakdowns and labor costs went

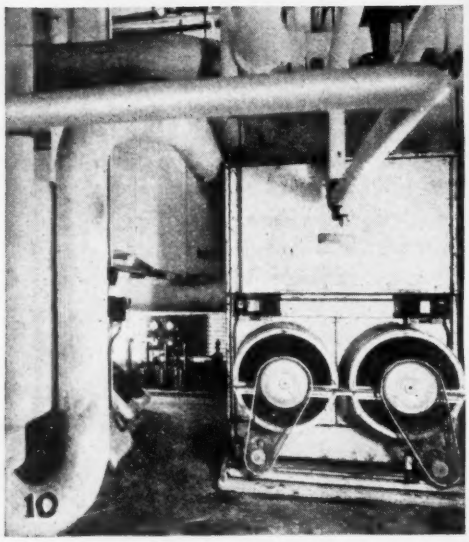
Practically the whole commercial development of bleeder heating of feedwater has occurred during this 15-year period. There came in the 1-, 2-, 3-, and 4-stage heating with heaters of the tube type. With growing steam pressures the upper heaters operated at higher and higher pressures, requiring very heavy construction. Now at Buzzard Point station in Baltimore we return to the old "open" or contact-type heater. Bled steam mixes directly with water to be heated, eliminating tubes. First costs and temperature drops are reduced.

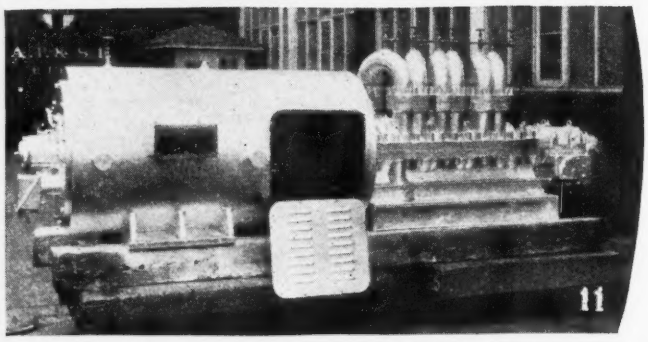
Proposed by W. L. R. Emmet back in 1914, the

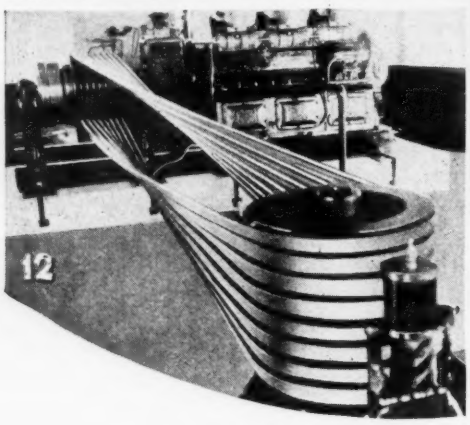


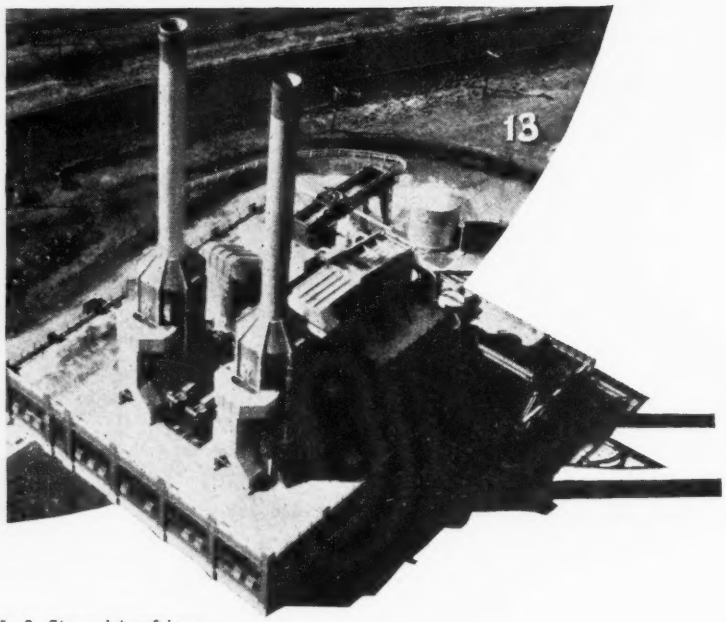


1,000-kw. gas turbine

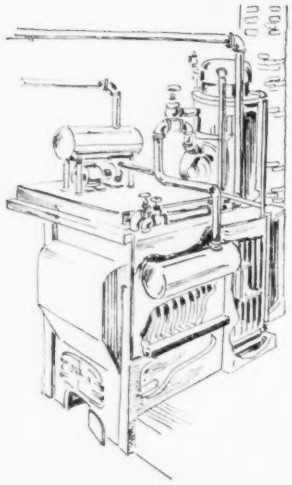








SHOTS OF 1935: 9, Steam-jet refrigeration; 10, Indoor cooling tower; 11, Gasoline cools pipeline pump motor; 12, V-belt with a twist; 13, The real mercury-steam plant



Left—Emmet's idea of a mercury power plant in 1920

mercury-steam plant was still a wild dream in 1920. In 1935 there are three commercial mercury-steam plants, located at South Meadow (Hartford, Conn.), Schenectady (N. Y.) and Kearny (N. J.) stations. Each of the two last-named has a 20,000-kw. mercury turbine and a mercury boiler with porcupine tubes and seven 30-in. drums with walls 4 in. thick. In 1920 one

"Perpetual motion"

pound of coal per kilowatt-hour was a distant and Utopian goal. Today the mercury-steam plant gets by on 0.7 lb.

The diesel engine, today on every tongue, was far from new in 1920, but it had a precarious standing in those days, hardly recognized in the better power circles. Many semi-diesel and hot-bulb engines were on the market. There was much talk about diesel unreliability. There were no standards for diesel fuel oil. In 1920 the gas-producer engine still had its advocates as a power-producing unit. Today we hear little of it and see less.

In 1935 the diesel industry moves ahead with sensational speed, already the favored prime mover for construction equipment, yachts and ships—widely used in industry, buildings and small central stations—sometimes found in buses and trucks. Speeds and reliability are up. First cost is down. Fuel oils are being standardized. Solid injection has largely displaced air injection, with its complicated air systems.

In buildings we find the automatic diesel, as at 1 Park Ave., New York, and the Singer Building engine supported on a concrete mat with weight distributed neatly by hydraulic cylinders. We find the Rockford Screw Products Co., Rockford, Ill., heating its shops for almost nothing with diesel cooling water. More and more often we find the diesel working in double harness with steam.

Accelerated by the post-war coal shortage, water power was booming in 1920. Niagara Falls was the Boulder Dam of those days, having reached a total capacity of 850,000 hp., counting both sides of the river. The biggest single unit of the day was 37,500 hp.

As this is written, Boulder Dam stands 735 ft. high. Behind it is forming the world's greatest artificial lake, 30,500,000 acre-feet. Laid out for 1,835,000 hp., the Boulder Dam plant is now installing four 115,000-hp. units and one 55,000-hp. and has ordered two more 115,000-hp. units. Other 1920 projects have the following projected ultimate capacities: Bonneville, 720,000 hp.; Grand Coulee, 2,700,000 hp.; Beauharnois (Canada), 2,130,000 hp. Government hydro projects under way in 1935 involve an initial investment of $400,000,000. Pumped storage has made great progress in Europe and is today the only widely used method of storing energy.

In 1935 the wonder of electricity still grows, with a 200,000-kva. generator, a 22,000-kva. frequency changer running in a tank full of hydrogen, and man-made lightning strokes of 10,000,000 volts.

But perhaps I am laying too must stress on the big numbers. The real power milepost of 1935 is *control*. The crude "regulators" of 1920 bore little resemblance to today's complete combustion control systems. And if any engineer of 1920 had desired a reputation as a crackpot he could have gotten it quickly by predicting today's manless pumping plant. Robots start and stop pumps. Over a wire, they report back the water level, bearing temperatures and so on. Uncanny, yet nothing but today's standard practice.

Pumps, long ago "perfect," are now improving so rapidly that units 10 years old have been junked for new ones that paid their cost in one year. Capacity limits move up and up. Each of the twenty 520,000,000-g.p.d. pumps planned for Grand Coulee will deliver against 370-ft. head and require a 33,000-hp. motor drive.

Power men didn't think so much of fusion welding 15 years ago. They talked a lot about the "human element" and "cast metal." Today welded boiler drums for 1,400-lb. pressure are accepted without question, and welded steam and water piping is becoming standard for all pressures. Complete lines of welding fittings work hand in hand with perfected gas torches, arc-welding machines and flux-coated welding rods.

Air Conditioning is Old

We had air conditioning in 1920 and long before, but the public and the general engineer hardly knew the name that is on every tongue today. We air-condition homes, buildings, offices, as well as manufacturing plants. With air conditioning has come an enormous development in refrigeration, fans, cooling devices. Indoor cooling towers remove the limitation of roof space.

In the field of mechanical transmission we see new activities, new devices to meet the competition of the motor. We find the modern V-belt drive, and all sorts of improved transmissions using flat belts, gears, chains, etc. Mechanical drive is fully established and finds its greatest application in combination with its old enemy, the electric motor.

Elevators ran at a maximum speed of 700 ft. per min. in 1920. Today at the Rockefeller Center, New York, they travel 1,400 ft. per min., stop and level automatically. Little is heard of the hydraulic elevator so widely used in 1920.

"Metal spray" comes into wide use to deposit copper, lead, zinc, aluminum on metals, and even on organic substances, for protection and better appearance. The vacuum cleaner is at home in the modern plant.

These are spectacular examples of the power changes of the last fifteen years. But remember that many of the plants of 1935 are still, in reality, plants of 1920. Only last year, *Power's* survey of 454 better-than-average plants showed 69% of the power-generating equipment over 10 years old and 43% over 20.

Thus power marches on, but not in all power plants. Therefore, I feel that in choosing a 15-year period for this review I have not gone beyond that of practical interest. The progress shown represents no more than that which the average American plant, particularly the average industrial plant, can accomplish at a single stroke by the modernization of equipment.

PROPELLER BLOWERS, TURBINES, VISCOSITY AND PIPE BENDS IN

POWER SESSION

Viscosity of water and steam up to 3,500 lb. pressure and 1,000 deg. reported; development of new propeller blower for generator ventilation described; suggestion to charge turbine with kinetic energy in steam at the throttle

ANNUAL MEETING
DECEMBER 2 TO 6

VISCOSITY OF WATER AND STEAM

INCREASING use of dimensional analysis in correlating data and solving problems in the field of heat transfer and fluid friction has made viscosity an important physical property in fluids. Data on the viscosity of water in superheated steam are very meager or nonexistent at temperatures and pressures used in modern power-plant practice. As these data were necessary to an investigation of flow distribution in forced-circulation steam generators, G. A. Hawkins, H. L. Solberg and A. A. Potter set out to measure viscosity of water and superheated steam at pressures up to 3,500 lb. per sq.in., and temperatures up to the critical in the case of water and between 800 and 1,000 deg. for superheated steam. The results of their work were reported in "Viscosity of Water and Superheated Steam."

The Lawaczeck viscometer was selected as being the most suitable type for the range of conditions encountered. It consists essentially of a metal weight falling in a tube closed at its lower end and having a diameter which is slightly greater than that of the weight. As the weight falls, the liquid is made to flow with streamline motion through the annular space between the weight and the tube. The accurately bored tube is placed concentrically within a seamless steel pipe capable of holding safely the maximum pressure to be used. This outer pipe or container was closed at the lower end by welding and was fitted with flanges at the upper end to allow for insertion of the tube and fall-bodies, and for periodic inspection. Two trunnions were secured to the container to serve as a support about which the apparatus could be rotated to an angle of 180 deg. The temperature of the fluid could be regulated by an electric heating coil which was wound around the container and thoroughly insulated.

In operating the instrument, it was necessary to observe the rate of flow of the body dropping in the tube, which proved one of the difficult problems in developing the viscometer. An a.c. bridge amplifier and recording milliammeter were finally selected as the most satisfactory solution to this problem. Two coils were wound on the tube, spaced about 14 in. apart. When the fall-body passes through either coil the circuit is unbalanced sufficiently to swing a pen across a chart on the recording milliammeter.

Discussion

Dean Potter disclosed that tests had been made to determine the effect of shape and density of the fall body on the viscosity determinations by using fall bodies made of magnesium and aluminum. Results in these tests agreed with previous results within 2%. Professor Croft indicated it to be his belief that velocity flow and size of apparatus influenced viscosity. According to Professor Keenan, viscosity is such an important property of water and steam that these values would be included in any future steam tables.

IMPACT PRESSURES PROPOSED IN TURBINE TESTING

IN THE course of a revision of the A.S.M.E. Test Code for Steam Turbines, there arose an informal discussion of the method of observing data for computation of turbine efficiency. The discussion resulted in a proposal to use impact pressures and temperatures in the computation of turbine efficiency. To give wider consideration to this proposal than committee membership affords, C. Harold Berry presented "Steam Turbine Testing," which explains the reasons for the proposed change.

Thermal efficiency of a turbine is the ratio of the work delivered to the aggregate energy chargeable against the turbine. Engine efficiency of a real turbine is the ratio of work actually developed to work that would be developed by an ideal engine receiving what the real turbine receives and exhausting at the pressure at which the real machine exhausts.

Test data underlying these computed values are the test steam rate, together with the pressure and temperature of the steam just ahead of the main throttle valve and strainer, and the pressure prevailing at the exhaust of the turbine. In observing these actual operating conditions, precautions are taken to insure, in so far as possible, that the pressures measured are true static pressures.

The aggregate energy chargeable against the turbine is not only the total specific heat, or enthalpy, as determined from steam tables from static pressure and temperature observations, but is equal to this enthalpy plus the kinetic energy of the steam just ahead of the main throttle valve. Consistency with this point of view also demands that the aggregate energy exhausted by the turbine be taken as the sum of the enthalpy of the exhaust steam and its kinetic energy. With respect to exhaust conditions, it is proposed that the ideal turbine be allowed the same leaving kinetic energy that characterizes the real turbine; that is, it is proposed that the space restrictions that fix the exhaust kinetic energy of a real machine shall be imposed upon its ideal counterpart.

In determining the aggregate energy in the steam supply we are not interested in its partition between enthalpy and kinetic energy. To this end we may measure the final pressure and temperature obtained by a sample of steam that has been removed from the flow stream, and compressed isentropically to such an extent that the increase in enthalpy is equal to the kinetic energy that the steam had before it was taken from the moving stream.

It is commonly recognized that a properly oriented impact tube will read the final pressure resulting from this imaginary compression. With respect to temperatures, there are reasons for believing that any thermo-metric instrument of appreciable dimensions extending into the stream will read the final temperature of such a compression, or something close to it. The bombardment of the thermometer by the moving steam contributes energy to it just as does the heat transfer. It appears that the enthalpy as determined by impact pressure and the impact temperature, may be taken as equal to the aggregate energy of the fluid in the moving stream.

It is proposed that the ideal turbine be charged with the kinetic energy of the steam supplied to the real machine, and permit the ideal turbine to lose, without charge, the kinetic energy of the exhaust from the real machine. These two quantities might chance to be equal, either may be the larger. In general, the net result will be small. This being so, it appears that the choice between the long customary method and this new proposal may safely be made on the basis of prejudice, convenience, or probable accuracy.

Discussion

Prof. F. O. Ellenwood expressed the opinion that it was proper to use impact pressure in determining conditions of steam at the turbine inlets but disagreed with the author with respect to conditions at exhaust. In his opinion, exhaust velocity of the ideal turbine should be considered as zero. J. J. Grob felt that before the change as suggested in the paper is made the technique of

measuring impact pressures should first be developed. He presented some data obtained in an attempt to measure impact pressures in the exhaust of the 160,000-kw. turbine at Hell Gate which indicated a considerable variation in the values obtained both due to location of the tube and its direction with respect to steam flow. P. H. Hardie pointed out that in most turbines the exhaust is downward and that therefore the impact tube must point upward. He questioned what would be done to prevent moisture in the exhaust from collecting in the impact tube.

FLOW CHARACTERISTICS OF VARIABLE-SPEED TURBINE

IT IS a well-known fact that the weight of steam flowing through a reaction turbine varies peculiarly and appreciably with the speed of the turbine. A general relation between the characteristic variables of a whole reaction blading group with uniform blade profile and uniform velocity ratio is derived by Adolf Egli in "Flow Characteristics of Variable-Speed Reaction Steam Turbines." The type of blading considered in the paper is, with the exception of the last few rows in condensing turbines, the only one used in modern reaction turbines. With this relation, which is plotted graphically, is presented a method for calculating the peculiar variation of weight of flow in variable-speed turbines.

ELECTROSTATIC PRECIPITATORS

THE electrostatic precipitators at the central heating station in Washington, D. C., were described by C. W. Hedberg, and some of the operating results and experience obtained with them were presented.

In these precipitators, flue gas flows vertically in lanes formed by steel collecting electrodes. These plates have slots pressed in them arranged so that the dust collected falls down through the slots and into a dead air space between two adjacent electrode sheets. The electrodes are supported at a single point in the top so that they may swing as a pendulum. The rapping device pulls each electrode to compress a spring and when released the spring forces the electrode to swing out and bump aganist an anvil which jars the dust loose, causing it to fall through the slots. Rapping of the plates is continuous, each plate being rapped every 2 min.

The precipitators were guaranteed to remove 90% of the solids, and this guarantee was exceeded. Each precipitator uses 14 kw., and draft loss through them is $\frac{3}{4}$ in. water. Collection ranges from 1 to $4\frac{1}{2}$ tons per day at a load of 175,000 lb. of steam per hour.

Discussion

J. J. Grob described a spray-zone flue-dust eliminator in use at Hell Gate Station, where at a load of 400,000 lb. of steam per hr., a dust-collection efficiency of 97% is obtained. These eliminators also remove a high percentage of sulphur.

Discussion also brought out that these precipitators with steel-plate electrodes weigh 60% of the weight of the usual precipitator with concrete electrodes. Gas velocity is about 8 to $8\frac{1}{2}$ ft. per sec.

PIPE BENDS

IN 2-dimensional or plane pipe bands subjected to changes of temperatures, reactions at anchorages are in the plane of the bends. Calculations of couples and forces acting on any section of such piping are relatively simple. When a pipe is so shaped as to lie in three planes, even if at right angles to each other, the subject is more complicated, not only because three coordinates must be used instead of two, but also because torsional couples are produced and the curved parts deflect out of their plane. In "Stresses in Three-Dimensional Pipe Bends," William Hovgaard presents an algebraic method of calculating the couples, forces, and stresses in a 3-dimensional pipe line fixed at the ends, consisting of straight parts at right angles to each other connected by quarter bends. The solution is complete in that it takes account of bending, torsion, compression and shearing. It comprises a special discussion of the rotations and deflections of quarter bends when subjected to forces and couples acting normal to their plane, with particular application to the three-dimensional pipe line. An analysis of the stresses at the terminal section, and in the bends, is given, together with a discussion of the strength criteria and the permissible working stresses. A numerical example is worked out to illustrate the application of the formulas.

PROPELLER BLOWERS

IN RICHMOND station of Philadelphia Electric Co., a 165,000-kw. turbine-generating unit has been installed in space originally intended for a 50,000-kw. machine. To meet space limitations required development of an airfoil-type blower, Fig. 1, for ventilating the generator. A maximum of 170,000 c.f.m. of air is required and four 57,000-c.f.m. fans were selected, one a spare.

A study of space available under the generator indicated that the usual type of blower would not fit in with any reasonable system of air ducts, so development of a propeller-type blower of high speed and small dimensions was undertaken. As two or three blowers would run in parallel, their characteristics had to be such that good parallel operation would obtain. As they were to be part of a closed ventilating system, it was necessary to provide them with suitable intake ducts. The speed adopted for the motors is 3,550 r.p.m., the highest for a 60-cycle machine, and the motors are designed for full-voltage starting.

Development of these fans, which included building and testing a quarter-size model and testing of the full-sized fan was the subject of "An Airfoil-Type Propeller Blower for Ventilating Electrical Machines," by C. E. Peck and M. D. Ross, of Westinghouse.

Results of tests on the full-sized fan with guide vanes and diffuser are given in Fig. 2. Performance includes effects of the inlet box. Power input to the fan includes the thrust-bearing loss, which is of the order of 1.5 kw. The model test with similar guide vanes and diffuser checked full-size performance closely. Maximum static efficiency on the model was 77% and on the full-sized unit maximum static efficiency was 78.5%, including the loss due to the thrust-bearing. The close check between the model test and full-sized unit indicated that the different methods of test used on the model and full-sized unit were satisfactory. Total efficiency, with guide vanes and diffuser, based on the static pressure plus the axial dynamic pressure at the diffuser discharge, is 82.5% including effect of inlet box and thrust-bearing loss.

In a summary of the results of designing, building and testing a fan of this type, the following possible advantages were suggested.

1. Within certain limits the performance and design proportions can be predetermined accurately.
2. From a mechanical standpoint, the propeller is particularly adapted for high speeds.
3. The intake box has little effect on fan performance.
4. For the pressures and volumes used in this application, the size of the unit is reasonably small.
5. Fan efficiency is high.

Fig. 2—Performance curves of full-size fan with guide vane and diffuser

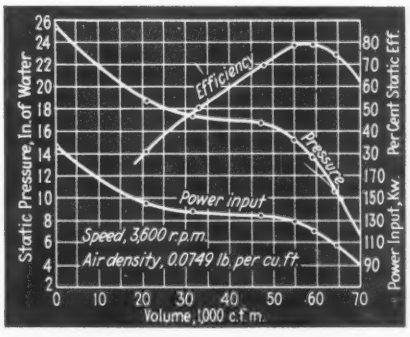
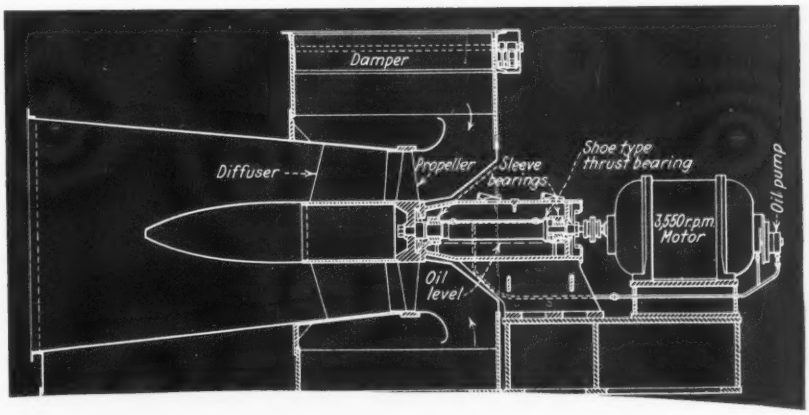


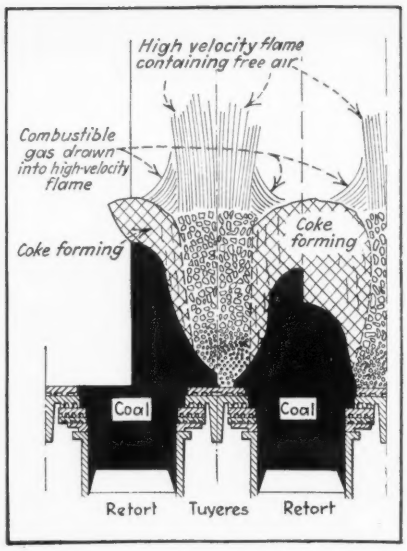
Fig. 1—Cross-section of the full-size propeller-type fan



FUEL ENGINEERS DISCUSS

STOKERS

Stokers formed the main topic at two sessions on fuels. Results with automatic zoned and metered air control and experience with a new water-cooled stoker were features



Burning action in underfeed stokers

SELECTION OF COAL FOR UNDERFEED STOKERS

AN ANALYSIS of data on 7,284 industrial plants, accumulated by Appalachian Coals, Inc., reveals that of the 19,634,266 tons annually consumed by these plants 48.1% is burned on underfeed stokers, 20.8% by hand-fired grates, 16.4% as pulverized fuel, 8.9% on chain-grate stokers, 4.6% on overfeed stokers, and 1.2% on spreader stokers. In these plants it was found that there were 8,378 hand-fired boilers averaging 1,068 sq.ft.

In keeping with the results of this survey, the Fuel Engineering Division of Appalachian Coals devoted a series of five monthly meetings, attended by 40 to 50 fuel engineers, to a discussion of selection of coals and their use on underfeed stokers. A review of the conclusions reached in these meetings was presented in "Factors in the Selection of Coal for Underfeed Stokers," by R. L. Rowan, L. A. Shipman, T. H. Queer, F. J. Kasper, O. O. Malleis, and J. E. Tobey.

Most common and undoubtedly poorest method of selecting coal is that wherein the buyer, frequently disregarding the origin of the coal, bases his selection on proximate analysis and heat value. This is simply blind buying of heat units over the counter, and does not make for ultimate satisfaction with respect to performance and economies.

Trial-and-error method of selection, in which the power-plant engineer acts as judge, basing his conclusions upon results obtained, is a more reliable and satisfactory basis for selection. In fact, there is nothing seriously wrong with the trial and error method, except that it is sometimes an expensive and long drawn-out procedure.

As a rule, coals which give the least trouble in a given stoker installation usually prove to be the most economical coals to use, and, conversely, coals which cause serious trouble and result in high maintenance are usually neither efficient nor economical. Excessive maintenance usually reflects poor combustion and undesirable conditions, not the least of which is a poor reliability factor and frequent boiler outage.

Preparation of coal by sizing and cleaning frequently alters its burning characteristics and is therefore important to industrial consumers. It is equally as important as any other item involved in the purchase and use of coal, and should command the interest of those engaged in the design and operation of plants, as well as those having charge of coal purchase.

There is a great need for more specific information as to what transpires in a fuel bed, particularly as concerns the release of hydrocarbon. It is suggested that the distribution of fuel on an underfeed stoker, at a cross-section, may be somewhat as is shown by the illustration, which includes views of high, medium and low rates of burning.

The figure suggests that the quantity of green coal which will be over the tuyeres will increase with the rate of burning and that at the same distance down the stoker, thickness of the cap of coke over the retort will decrease with increase of rating. It would also be expected that thickness of the cap at a given rate of burning will increase with distance from the wall. Such a picture would account in large measure for the blowing of fuel beds and high carbon losses at high burning rates. Above the fuel bed is illustrated the possible mixing of the distilled gases with air for combustion.

Breaking up of coke formed from the coal on a multiple-retort stoker is not affected to any great extent by mechanical functioning of the stoker. Movement of fuel by the main, feeding or secondary ram serves to distribute the coal, but produces little mechanical-agitating effect. Breaking up of the fuel is dependent on reactions of the fuel itself. Coals which swell considerably upon coking break up from internal stresses set up by this swelling. Coals which swell only slightly do not break up to such a great extent.

Some coals form hard, dense coke masses that fracture or break up much less rapidly than others, and as a result offer considerably more resistance to air flow. Some coals form small friable masses that are easily blown off the stoker. Some coals contract somewhat after initial coking thereby causing fissures through the coke masses. Therefore, it will be seen that the condition of the coke over the tuyere rows will depend largely on the character of the fuel itself, and is a primary factor affecting the resistance or porosity of the fuel bed.

Rate of combustion has a pronounced effect on the character of coke produced and operation of the stoker. Usually the pieces of coke will be larger and the fuel bed thicker at low rates of combustion. At higher rates, where the coke is formed more quickly, the pieces may be very small and it may be necessary to carry a thin fuel bed.

At one stage during the coking process, the coal is in a plastic state, and it is now believed that the plasticity or plastic range has much to do with the fuel-bed performance of a coal. It is apparent that coals having a long plastic range will offer a greater resistance to air flow than those having a shorter range.

There are a large number of chemical and physical properties of coal which influence its combustion. Among these are heating value, ash content, volatile matter content, coking properties agglutinating value, size and size composition. The effects of these various properties on combustion in coal selection are discussed in the paper, as well as the effect of design on combustion behavior.

Discussion

Percy Nichols drew attention to the lack of available data from plants that have had experience with different kinds of coal and hoped that those who do report such data would tell what caused poor operation with certain kinds of fuel. He stated that his experience indicated that at present there was little hope for a formula that could be applied to coal selection.

E. G. Bailey presented results of other surveys which seemed to indicate that the use of pulverized coal was greater than the 16% indicated in the survey. Several discussions indicated that the plastic characteristic of coal was greatly affected by the atmosphere in the stoker and also the value obtained in the test was affected by the atmosphere in which the test was conducted.

Prof. A. H. White indicated that they had been working with a small test underfeed stoker in which they were able to observe that a hard clinker was formed when the ash fused, but when the ash simply became soft that a soft clinker resulted.

WATER-COOLED UNDERFEED STOKER

THE coal codes under government control affected the local fuel situation at Cedar Rapids plant of the Iowa Electric Light & Power Co., making certain coals more attractive if they could be burned successfully. One coal obtained from a Northern Illinois mine was found substantially lower in price on a

B.t.u. basis, but could not be burned on existing underfeed stokers, because of its low ash-fusing temperature, which runs slightly in excess of 1,900 deg. This coal has an ash content of 10% and heating value of 10,436 B.t.u.

It was concluded that the most effective method of handling this situation was to water-cool the stoker. Development of this stoker, together with results obtained, was described by J. F. Bennett and C. J. Herbeck. Water walls supplied with water drawn from the boiler by a booster pump were in service on all four sides of the furnace. It was therefore possible to apply some of these same forced-circulation tubes to the existing stoker construction. The first step was to apply cooling tubes to the tuyere as shown in the photograph. Cooling the tuyere section in this manner had a pronounced effect on the behavior of the fuel. The fuel bed appeared more porous, the air ports were kept open at all times, and problems of coal distribution on the underfeed section disappeared. However, when the fuel bed reached the non-water-cooled section at the lower end of the stoker, the flow of fuel was interrupted, which seriously impaired the operation of the unit as a whole.

The next step taken was to extend the cooling, formerly stopping at the tuyeres, across the overfeed section. The moving overfeed section immediately under the tubes was made stationary, but movement between the tubes was retained. This improved the situation but difficulty was still encountered in feeding the fuel beyond the end of the tuyeres. The horizontal tube section was next eliminated by advancing the tuyere section toward the rear wall. This straightened the tubes and helped conditions materially, but was not entirely satisfactory.

At this point is was felt impractical to solve the problem completely without rebuilding the entire stoker, and Iowa Electric Light & Power Co. arranged for fabrication of a complete new stoker. Ideas crystallized in designing this machine suggested the possibility of making a stationary water-cooled overfeed section. To make sure of this, it was decided to replace the moving overfeed section of the rebuilt stoker with stationary water cooling. With the chilled surface provided by the stationary air-admitting section at the rear as in the illustration, the refuse could be fed across easily and reliably. The experimental stoker now operated reliably and efficiently, so seven stokers were converted as quickly as possible to embody all features described.

One effect noticed when water cooling was applied was the reduction in power required to drive the stoker. The fuel beds appeared to be looser and moved more freely, and fused ash did not accumulate on the underfeed section. The furnace was as clear and free from smoke with the water-cooled stoker as it was with the air-cooled type.

Further attention was directed to the possible abrasive effect of the fuel traveling over the tubes, especially on the overfeed section. Although a number of tubes have been in the furnace for 16 months, no appreciable wear can be detected, and some show the original scale and shop marks.

It was found that the northern Illinois coal which has much more troublesome characteristics when burned on water-cooled stokers, gave an efficiency equal to those obtained with Iowa and Western Kentucky coal burned on conventional air-cooled stokers, and the reliability of the water-cooled stokers was much greater. Thus far, there has been no stoker-furnace maintenance on the water-cooled stokers except routine inspection and cleaning.

The new stoker was placed in service in May, 1935, and up to the time of writing, none of the furnace portions of the stoker have required replacement. In an effort to determine whether any weakness existed, large portions of the stoker were left uncovered by fuel and a continuous day and night run for seven days was conducted with extremely low excess air and as high as 17% CO_2 at the boiler outlet. During this run the slag ran down the walls constantly, but no operating trouble was encountered and at the end of the run the stoker was found to be unharmed. Fuel-burning rates up to 54 lb. per sq.ft. of air admitting surface per hour have been maintained, with negligible combustible in the refuse. Maximum coal-burning capacity has not been determined because of limitation imposed by draft and the boiler.

Discussion

C. J. Herbeck indicated that, after burning 75,000 tons of coal on the water-cooled stoker, maintenance had amounted to about 0.1 cent per ton on the tuyere section. Heat absorption by the water-cooling tubes amounted to 25,000 B.t.u. per sq.ft. of projected tube surface per hour at low ratings and to 29,600 B.t.u. per sq.ft. at high ratings. The latter amounted to 2.2% of the total heat liberated in the furnace. During eighteen months of opreation, wear on the cooling tubes had amounted to only 0.001 in.

V. E. Alden expressed opinion that the water-cooled stoker was the answer to the use of high-temperature preheated air. In answer to an inquiry, the author indicated that the water-cooling tubes were 3 in. in diameter and in the later installations the cooling tubes are tied into the natural circulation of the boiler.

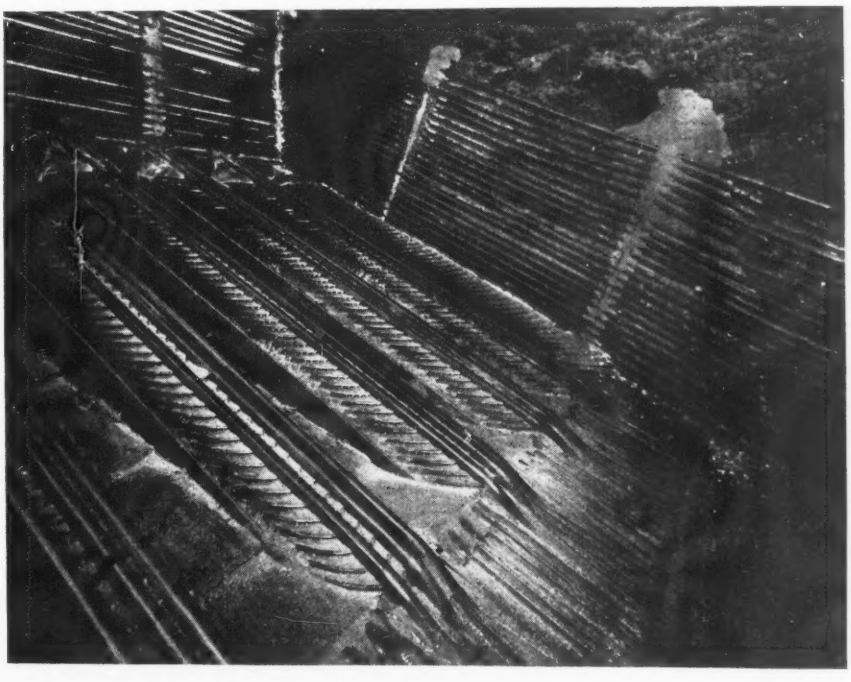
FURNACE BOTTOMS FOR TAPPING ASH

DESIGN and performance of slag-tap furnaces, based on experience with 80 installations, was presented in a paper by R. Shellenberger. Slag-tap furnaces as applied to steam boilers was brought about by the economic desire for burning efficiently the cheapest coal available at any given boiler plant location, and obtaining the increasingly higher capacity and availability required from the installation of a single boiler unit.

Two principal difficulties encountered with furnaces having refractory bottoms were the expansion due to the opening and filling of cracks and the inability of the furnace bottom to contract after each expansion period. A factor aggravating these difficulties has been the formation of iron sulphide from pyrites in the coal. A remedy for the difficulty with iron sulphide has been found to lie in pulverizing the fuel fine enough and completely burning it so that the iron is always in the form of an oxide instead of a sulphide.

Furnaces may be designed for either periodical or continuous tapping of slag. Where slag is tapped intermittently from a water-cooled bottom, the slag is found to chill for a certain distance up from this bottom. After the fluid slag is tapped off, the viscous slag underneath gradually becomes molten and drains off until an equilibrium point is reached beyond which rate of tapping is insufficient to warrant continuation of the operation. In intermittent tapping the slag is tapped from one to three times per day, depending upon the load carried by the boiler and the quantity of ash in the coal. Usually one tap per day is sufficient, and the slag level is lowered from 3 to 8-in. The stream of slag usually drops onto a flat spray of multiple water jets which reduce it to the solid form and disintegrate it to the size of coarse sand. Additional jets then sluice it along to a sump or tank. The tapping operation is usually completed within 1 to 3 hr.

Final arrangement of water-cooled stoker at Cedar Rapids plant



Water-cooled liners are now universally used in slag spouts in this service.

Continuous tapping is a later development, on which the range of experience is not as great. Broadly speaking, the principle of continuous tapping is based on keeping a fairly large tap hole, located centrally in the furnace bottom, free and open by withdrawing some of the hot furnace gas through the opening. Since there is a continuous flow of hot slag from all parts of the furnace toward a tap hole, water-cooling the floor in some manner is usually necessary to prevent progressive erosion.

Experience as regards horizontal versus vertical firing, using turbulent burners, has not fully crystallized the field for each, but in general the vertical burner arrangement lends itself better than does the horizontal to high heat inputs per foot width of furnace. A combination of vertical and horizontal burners permits using more of the furnace volume and achieves a wider load range for best economy and ability to tap at low loads. Burners for slag-tap furnaces must produce a short, snappy flame in which the hot spot of the furnace is at the surface of the slag bed.

Discussion

H. D. Harkins said that for capacities for 75,000 lb. of steam per hour and over, a slag-tap furnace was less costly than a dry-bottom and that it requires from 10 to 15 ft. less headroom. He had come to the tentative conclusion that interruption of burners was less in furnaces having intermittent slag tapping. W. E. Caldwell said that he had found that slag-tap furnaces increased ignition stability at low ratings, and with direct firing there were no puffs as sometimes occur with dry bottoms, thus permitting lower ratings. H. G. Thielscher indicated that the bottom-supported slag-tap surfaces at Buzzard Point had been successful. He reported also that some wear had occurred at the slag spout, indicating that a 1-year life may be expected. In his opinion, slag taps are better placed at the side than a rear tap as at Buzzard Point. He reported that they had found an accumulation of iron in the furnace bottom which it was necessary to cut out with a torch about once a year.

DISTRIBUTION OF AIR TO UNDERFEED STOKERS

AFTER discussing the necessity of controlling the distribution of air ot underfeed stokers and tracing the previous methods that have been used, A. S. Griswold and H. E. Macomber described in "Distribution of Air to Underfeed Stokers," development of air-control systems for the underfeed stokers at Delray No. 3, Beacon Street heating plant, and the new boilers at Conners Creek.

At Delray, the tuyere stack is divided into four approximately equal zones corresponding closely to the portion of the fuel bed controlled by each pusher. Each zone is subdivided according to the tuyere stacks into fourteen parts, and air is supplied to each of the resulting 56 subdivisions through individually automatically controller dampers. Each control unit consists of a duct and two independent cage type dampers arranged in series. First damper functions as a variable measuring orifice and its opening is automatically adjusted with variations of the plenum-chamber pressure. Second damper attempts to maintain automatically a fixed differential pressure across the measuring orifice irrespective of variations in fuel-bed resistance over that particular area. All of the measuring orifices are connected together through a linkage system so that all have the same opening.

After a long period of observation and testing, it has been concluded that although this system has some desirable features, it is lacking in many important respects. It has definitely established that at both normal operation and under test conditions higher percentages of CO_2 can be produced when the control is in use. Because of its bulk a large plenum chamber is required, and in spite of precautions taken, its operation is hampered by dust sifting from the stoker. Because of small motor forces available, the equipment has lacked sensitivity, a characteristic now recognized as essential if the over-compensating feature is not incorporated. There is a large pressure drop through the control unit, and plenum chamber pressure is practically double that of a similar stoker without air control. In addition, the control does not report to the operator whether it is functioning correctly.

At Beacon Street heating plant, a manually air-controlled system was installed. Here the tuyere stack was divided into two zones. Air is supplied to each tuyere zone through fifteen adjustable-throat venturi tubes, one for each tuyere stack. Air flow in each is regulated by a damper installed in duct above the venturi throat. A sliding wire in a flexible tube extending to the boiler gage board is used to operate the damper, and the position of the button on the end of the wire indicates the position of the damper. Inclined differential draft gages connected to venturi tubes are used to indicate flow of air. The third or extension grate zone for each of the stokers, because of structural difficulties, was divided into only four sections.

Although not anticipated, the Beacon Street installation of air control made possible a large increase in maximum dependable fuel-burning rate of the stoker. The maximum coal-burning rate increased from 63 lb. per sq.ft. per hr. to 78, resulting in an increase of 23% in steaming rate. When all four boilers at this plant are equipped with metered air control, they will be able to serve the load which originally would have required five boilers. Aside from the combustion considerations, this control is of measurable value in reducing the cost of stoker maintenance.

This system was found to possess certain disadvantages, but considering the results achieved, none of them is serious.

The air-control system installed under the new boiler at Connors Creek has meters and dampers resembling those at Beacon Street, but the dampers are operated by hydraulic power cylinders controlled from diaphragm-type regulators. Grate surface of the stoker was divided into three zones. Division of the zones differs from that previously used, in that the tuyeres are center divided so that tuyere stacks are partitioned down the middle. Each venturi tube furnishes air to half of the tuyere stack on adjacent sides of each retort. Also, the extension grates are provided with a venturi tube for each retort section. Thus, for the double 12-retort stokers, a total of 72 meter control dampers are required for the six zones.

Primary function of the control is to maintain a constant flow of air to the area under control, irrespective of change in fuel bed resistance. All regulators of one size have the same simultaneous adjustment through loading pressure diaphragms, therefore equalized airflow is maintained continuously through all meters.

One set of twelve, and one set of six, airflow gages are provided for each boiler. A gang valve permits connection of the twelve set to all of the venturi tubes in any one selected zone. One unit of the 6-gage set is connected to a key venturi in each of the six zones. With this combination it is possible to check the action of all the regulators.

Tests during the first year's operation have definitely established that, with the control system, the stokers are capable of attaining the fuel burning rate expected, that is, 75 lb. per sq.ft. of projected grate surface per hour. Excess air in the furnace was 12%, and there was neither measurable combustible in the gas nor smoke at the end of the superheater pass. Because of the increased reliability of the stoker the continuous operating period between shutdown is greatly lengthened and maintenance costs are correspondingly decreased.

Installation of the air-control system at Connors Creek cost $20,000 per boiler, a total of $220,000 for the twelve boilers. This investment offset an otherwise possible investment of $1,500,000 for two additional boilers that would have been required because of the lost capacity that would have been caused by the absence of the air control system. It is estimated that the installation at Connors Creek will save $3,000 per year in stoker maintenance.

Discussion

J. N. Landis presented data showing the results of operation at Hudson Avenue with and without zoned air control on eight of the new stokers. These results indicated that under the load conditions at the plant there was no improvement in efficiency, and that the maximum fuel-burning rate was 29.8 lb. per sq.ft. per hr. He expressed the opinion, however, that if operating load increases there will be found a gain in efficiency with the automatic control equipment and that there will be a gain of from 30 to 40% in the peak load that these boilers can supply with steam.

J. Armour pointed out that the curves of pressure resistance through tuyeres and the fuel bed, indicate that the area of the air opening in the tuyeres is not important, but that the design for distribution of the air from the tuyeres is most important. J. F. Bennett pointed out that there is no information available yet concerning the results obtainable with automatic air control when poor coals are used, but that there is an installation being made from which he hoped experience would be made available. Fred Chatel observed that it is most important that indicators be provided so the operators will know the position of the dampers and the air flow to each zone, so the pusher strokes can be adjusted properly to meet varying fuel conditions.

HYDRAULIC SESSION THEME—

CAVITATION

Six papers at two sessions were devoted to research work being done in the United States and France, with particular reference to hydraulic turbines and pumps

VERY large sizes, high speeds, and other factors have made prevention of cavitation and pitting of hydraulic turbines and pumps a problem of large magnitude. For several years, studies have been conducted with an increasing intensity in universities, governmental and commercial laboratories. The six papers presented under the auspices of the Hydraulic Section, with the A.S.M.E. Applied-Mechanics Division and the Power Division, A.S.C.E., co-operating, gave latest developments in this work.

FLUTTER RESEARCH

UNTIL now, flutter has been given very little consideration in hydraulic design. It has long been recognized that pressures existing within a fluid are far from stable. Designers have been satisfied with time averages without minute examination of the importance of instantaneous variations, their cause and effect. W. Watters Pagon, consulting engineer, in "Cavitation and Erosion Investigated as a Problem in Fluid Mechanics," presented this element for consideration. This paper is not only a summary of the work done for Safe Harbor Water Power Corp., but is also a report of several years' study dealing with current research in aerodynamics. The author has made available to hydraulic engineers the fruits of the vast research in aerodynamics and fluid mechanics and interprets the results in the light of their applicability to hydraulics. His deductions are drawn not only from published results but also from close observation of research work in progress and from inspection of hydraulic turbines in operation.

It has been commonly assumed that the destructive forces in cavitation are caused by the passage of vapor bubbles from a low-pressure environment to a higher, with resulting sudden collapse. Although in general it may be true that collapse is accompanied by such a passage from one environment to another, nevertheless mathematical analysis shows that such a change is not necessary. Viscous eddies may in themselves cause the growth of cavities to the extent that they become unstable and then can collapse with great suddenness, even without external influence. It is obvious that whatever the cause, the process of collapse involves rapid changes of pressure or flutter. It can be shown that when the eddy closes it is entirely probable that the air may be compressed to as high as 3,000 atmospheres.

At this terrific pressure, air is no longer the light gaseous medium we are accustomed to think it, but has a density and compressibility about that of water. The collapse, furthermore, may not be simultaneous from end to end of the eddy hole, but progressive. Consequently, water hammer may cause a multiplication of the forces so that impacts much higher than could be derived, considering the problem in two dimensions only, may be exerted along the axis of the eddy, and the air may thus be injected or impelled into openings in the metal wall. Experience with different materials subjected to cavitation in various cavitation stands indicates that eddies do play an important part in producing erosion.

In the destructive effects that have been studied in the course of experiments at different stands and on materials of widely different characteristics, there is substantiated the belief that eddies cause the greater part of the damage, and that erosion comes particularly where the eddy axes may terminate against the metal wall at time of collapse.

Regarding the prevention of cavitation under given conditions of turbine operation, the author feels that there are two elements —first, the equalization of pressure distribution, and second, the suppression of flutter. He emphasized the need for further experimental research, particularly for repeating tests similar to those performed with air by Göttingen on blades in series, but using water instead of air.

M.I.T. CAVITATION RESEARCH

FOR several years, cavitation research work has been conducted at Massachusetts Institute of Technology. A second progress report was presented on this work by J. C. Hunsaker, head of the Mechanical Engineering Department, M.I.T. This report discusses information obtained regarding the relation between frequency of vapor collapse and the controlling variables. It confirms the opinion that the damage to surfaces caused by cavitation is severe only when the collapse is noisy, violent and regular. For such fully developed cavitation, the frequency of collapse is regular. When cavitation is not well developed, the frequency observed is highly irregular, severe shocks are infrequent or absent, and damage to walls is very slight.

Wall damage also appears to depend on the absolute size of the nozzle used, or the energy available in the cavitation volume. Tests with small nozzles, geometrically similar to large ones, produce little or no damage, even when cavitation conditions appear to be similar.

The conclusion from the current work is that cavitation of a type to cause severe damage requires, probably, some unique combination of variables of which exit flare or profile shape appears to be important. Therefore, a technique for the quantitative measure of the severity of cavitation damage is required. After experimenting with various materials, it was found that properly cured cement will progressively lose weight under cavitation attack, and it is planned to report tests of various cavitation conditions in terms of a scale based on loss of weight of cement.

PRINCETON WORK

"PROGRESS in Cavitation Research at Princeton University," by Lewis F. Moody, professor of hydraulic engineering, and Alfred E. Sorenson, assistant professor of engineering, describes test apparatus and an experimental method used to determine the critical point of cavitation. It is shown that the experiments give results entirely consistent with the cavitation principle as now generally applied.

While the authors have no basis for asserting that the cavitation formula will satisfy all conceivable arrangements of conditions, they draw the conclusion that these experiments appear to answer the question of the formula's validity, for the apparatus and conditions adopted by confirming it. This is true for two different values of back pressure, showing that the cavitation coefficient sigma remains constant and independent of the back pressure in accordance with the theory. It was found that, when dealing with hard waters heavily charged with salts, the vapor pressure may be appreciably higher than that given for distilled water in the steam table. When applying the formula to unknown waters, a small allowance should be provided in the value for the height of a water barometer, to cover this factor. At least, when using ordinary run-of-laboratory water free from abnormal air content, the formula appears to be perfectly satisfactory without modification.

HOLTWOOD TESTING

THE Holtwood hydraulic laboratory of Pennsylvania Water & Power Co. was put into operation early in the summer of 1930, and since that time has been in almost constant use. A paper on cavitation testing of model hydraulic turbines at this laboratory and its bearing on design and operation was presented by L. M. Davis, hydraulic test engineer of that company. Although most of

the work done in the laboratory has been in connection with the Safe-Harbor development, turbine models of three large projects have been tested for manufacturers on a rental basis. In addition to presenting results of these tests, they are compared with those obtained by other investigators in this field.

When discussing benefits derived from tests made in co-operation with the manufacturers in connection with design and improvement of the Safe-Harbor units, the author points out that in important installations strict accounting of water used is necessary for record and for economy in operation. It is seldom possible without unwarranted expense and loss of time in waiting for extraordinary circumstances to conduct formal efficiency tests over a sufficient range of head to gain complete knowledge of operating characteristics of the unit. Consequently, model tests are relied upon in interpreting acceptance-test data to cover the desired variety of conditions to draw up charts or tables necessary for daily operation and economic loading of units.

Efficiency at different speeds became of vital importance in connection with establishing the speed of Safe-Harbor unit No. 2 for 25-cycle power supply. Model tests indicated an appreciable gain in efficiency at 100 r.p.m. instead of 109.1 r.p.m., the 60-cycle units' speed. It was consequently decided to test one of the Safe-Harbor units at different speeds by means of an artificial load consisting of two other units operated as motors so that a direct comparison could be made between the model and prototype. Fig. 1 shows a comparison between the envelope efficiency obtained on this test and the envelope efficiency obtained on a 16-in. model at the same blade angle of 16.5 deg. It is felt that this unique experiment proved that the peak efficiency of a given runner design occurs at the same value of ϕ, which is the ratio between the peripheral speed of the runner and the theoretical spouting velocity of the water, regardless of runner diameter.

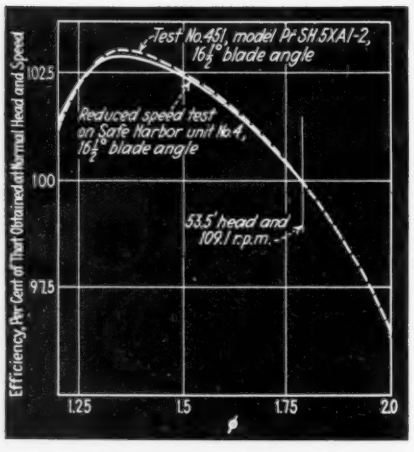
Operation of Kaplan units at Safe Harbor, the capacity of which are greater than other units installed so far in this country, has brought up many questions regarding their behavior as affected by cavitation. In seeking an explanation for observed facts and in establishing principles and policies in operation, the laboratory has served as a guide in many cases. Extensive tests have been made for determining what improvement in blade shape could be made in anticipation of installation of additional capacity. These tests have been sufficiently extensive in their scope to demonstrate the correctness of certain design principles.

Fig. 2 shows how Holtwood laboratory cavitation tests check with actual cavitation conditions at Safe Harbor. The solid curve gives the results of the field efficiency tests in per cent of maximum efficiency. The dotted curve shows the expected results from laboratory tests which are not affected by cavitation. The actual efficiency curve starts to depart from the expected curve at 33,500 hp. From laboratory tests using the break in the unit discharge versus sigma curve as the criterion for the starting point of cavitation, a limiting output of 34,950 hp. was obtained, thus showing a very reasonable agreement.

It should be borne in mind that the test from which Fig. 2 was drawn was conducted when the tailrace was particularly low, to determine what effect there would be from the worst conditions of cavitation. This does not represent ordinary operating conditions and therefore the reduction in capacity is not indicative of failure to derive rated output continuously from these units. With a normal forbay, the limitation apparently imposed by cavitation in Fig. 2 would be sufficiently raised so that the unit would deliver its full rated output.

It has been found from experience that it is possible to operate somewhat above the limit determined by the laboratory without accruing enough damage from pitting to be considered out of proportion to the benefit derived in increased output. Inconvenience caused by vibration at these high ratings is successfully combatted by injecting a moderate amount of air under the head cover.

Fig. 1—Efficiency — ϕ characteristics of a model and prototype. ϕ=ratio between peripheral speed of runner and theoretical spouting velocity of the water.



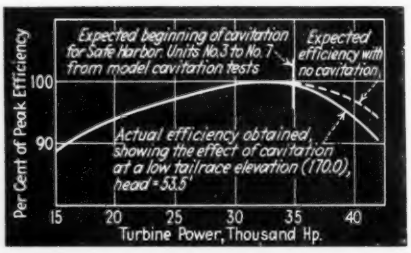

Expected beginning of cavitation for Safe Harbor Units No.3 to No.7 from model cavitation tests
Expected efficiency with no cavitation
Actual efficiency obtained, showing the effect of cavitation at a low tailrace elevation (170.0), head = 53.5'
Per Cent of Peak Efficiency
100
90
15
20
25
30
35
40
Turbine Power, Thousand Hp.

Fig. 2—Break in efficiency of prototype compared with that predicted from model tests

While the accomplishments in the past have proved the wisdom of establishing this laboratory for the purpose for which it was intended, the author expresses the opinion that there are still many other elements of turbine design which may have a bearing on its cavitation characteristic, which should be investigated. These include the shape of guide vanes arrangement of their scroll case, form of the head cover, design of the curb ring, influence of hub diameter and runner clearance. Furthermore, there will eventually arise important problems in connection with the development work necessary to secure the maximum amount of additional power from new wheels placed in existing equipment.

"CAVITATION Testing on Propeller Pumps," by A. Tenot, and translated by S. L. Kerr, gave a description of the laboratory at Chalons-sur-Marne for cavitation testing on propeller-type pumps and tests with photographs showing the progress of cavitation under various conditions of the cavitation coefficient sigma.

CAVITATION METALLURGY

At the Holtwood plant of Pennsylvania Water & Power Co., J. M. Mousson has been conducting an exhaustive series of tests on metals in a type of cavitation stand that permits accelerated cavitation over a limited area on test specimens. Results of an investigation of pitting of metals, on a number of specimens subjected to cavitation in the Holtwood testing equipment, were given by H. N. Boetcher, Consolidated Gas, Electric Light & Power Co. in "Failures of Metals Under Cavitation."

Conclusions are reached to the effect that in order to have high resistance against cavitation fatigue, the metal should have high corrosion resistance in the water in which it is used and physical and metallurgical properties that give high fatigue resistance. It should be homogeneous and free from inclusions. It should have high fatigue strength. This involves high initial hardness with satisfactory toughness, or susceptibility to considerable strain hardening, with good initial hardness.

Discussion

The papers and discussion pointed to conclusions that study of cavitation problems has been established on a sound scientific and engineering basis. Although much remains to be done before a complete understanding of cavitation phenomena is obtained, much has been accomplished that is of practical and economic value to hydraulic engineering.

Appreciation was expressed for the work being done at Holtwood cavitation laboratory on tests of model runners. This work has been very helpful to the waterwheel and pump manufacturers, and the wish was expressed that it be continued.

Carroll F. Merriam, when discussing A. Tenot's paper, expressed his appreciation of S. L. Kerr's work in translating that paper and what he has done to establish closer contact with the study of hydraulic problems in Europe.

Miss Mary O. Soroka called attention to the effects of barometric pressure and water temperature on propeller turbine capacity in low-head installations where cavitation is a load-limiting factor, as it is on large units of the propeller type. Low barometric pressure and high water temperature tend to increase cavitation effects and these reduce the load that a given unit can carry without serious cavitation. In the vicinity of Baltimore, the period of minimum barometric pressure and maximum water temperature occur practically simultaneously. These effects are additive and there is a possible variation of 15% in turbine output between the low barometer in summer and high barometer in winter, because of changes in the cavitation limit.

PUBLIC ENEMY NO. 2?

SILICATE

Caustic soda has a partner in its crimes against boiler metal—silicate. The need is now for more study

IT IS whispered that caustic soda, generally regarded as Public Enemy No. 1 of boiler metal, supposed cause of "caustic embrittlement," has a chemical side partner in crime. It appears that the boiler is not put on the spot by a single chemical, but by a gang of two at least, and that the other member is silicate.

This was the big news that leaked out the highly technical proceedings of the Joint Research Committee on Boiler Feedwater Studies, Thursday afternoon.

It was not an official announcement of the Committee, but a reasonable conclusion from statements made with many "ifs" and "buts" by chemists who have for years been playing the role of dectectives in the struggle against boiler embrittlement—notably Prof. Frederick G. Straub, the University of Illinois and W. C. Schroeder of the U. S. Bureau of Mines.

Over a period of years, thousands of dollars had been spent on this line of research. Steel specimens have been pulled and twisted cold and hot—in air, distilled water, and in every conceivable solution strength of caustic soda (sodium hydroxide). Professor Straub found that caustic soda caused embrittlement. Others found that it did not. They couldn't all be right, so the battle raged hot and heavy, with incidental reflections cast on the "crude" methods used by boiler manufacturers in forming plates and driving rivets.

It appears that Professor Straub had been using a "technical" hydroxide, a "commercially" pure brand. His experiments definitely showed that this made steel crack under stress. Other experimenters, notably Dr. Schroeder, used C. P. (chemically pure) sodium hydroxide, and found that the metal was practically unaffected under stress. Naturally, this disagreement caused a lot of confusion all around.

Professor Straub's suspicions of his chemical were aroused early this year, and he immediately instituted elaborate tests with C.P. caustic soda. Results: No embrittlement. Then he tried commercial caustic, made by another process; still no embrittlement. Next he took the C.P. caustic and added to it, one at a time, the impurities shown in the analysis of his original commercial caustic. Then it was that he discovered, apparently, that silicate—just a little bit of silicate—makes all the difference in the world. Professor Straub found, in short, that caustic soda alone does not cause embrittlement, as he had previously thought, but that caustic, plus a little silicate, does.

But, reasoned Professor Straub, most natural waters would furnish that much silicate in any case, so caustic soda in a boiler is still dangerous, C. P. experiments or no C.P. experiments, unless the A.S.M.E. recommended sulphate-carbonate ratios are maintained.

Meanwhile, Schroeder got busy along similar lines, adding various impurities, one at a time, to his C.P. caustic. He too found that silicate is the determining factor. Caustic soda may do the damage, but it won't work unless some silicate is present. Then he tried caustic plus larger amounts of silicate, and finally reached the point where he could reduce the metal strength as much as 70% in an eccentrically stressed specimen at boiler temperature.

This certainly is news to *Power* readers, particularly to those who have followed the never-ending discussion of caustic embrittlement.

In considering this new slant, the practical operating man should keep two points in mind. The first is that this silicate business has yet to be worked out in detail, although it appears to be "caught with the goods." The second is that the A.S.M.E. recommended sulphate-carbonate ratio still remains the only known certain way to prevent embrittlement. Beyond question, other more convenient ways to do the job will be found after the new live leads have been run down by chemical experts. Meanwhile, the sulphate-carbonate ratio technique works.

In spite of regrets for past labors, all concerned in this new discovery expressed keen satisfaction at the apparent solution of a major chemical enigma of the power field. Chemists did not enjoy contemplating a situation in which one of them, working presumably with the same chemicals, and with comparable apparatus, could not duplicate the tests results of another.

C. H. Fellows, chairman of the meeting, expressed the hope that boiler manufacturers, power companies, and others vitally concerned, would furnish the funds to pursue the various fruitful leads now disclosed. If they do, it seems quite possible that a truly rational method of preventing boiler-metal embrittlement may be found.

Two other papers dealt with "caustic embrittlement." A. S. Perry, of the Chesapeake & Ohio Railway Co., had studied the effect of concentrated sodium hydroxide on boiler steel under tension. He concluded from his work with an experimental boiler that cracking and failure can be produced in a boiler by using a concentrated sodium-hydroxide solution under pressure with abnormal stress, that impurities or segregation in the metal may be a contributing cause, that proper heat-treatment of rivets is desirable, that intercrystalline cracking can be produced without caustic soda, that the appearance of caustic embrittlement may be produced around rivet holes when no caustic soda is present, that conditions outside the boiler water contribute to boiler failure.

DENSITY READING TO DETERMINE SOLIDS

IN "Estimation of Dissolved Solids in Boiler Water by Density Reading," J. K. Rummel (Shanghai Power Co.) and J. A. Holmes of the National Aluminate Corp. presented the following conclusions from experimental work:

1. Certain types of hydrometers give reasonably accurate results.
2. These density instruments are preferably floated in cylinders at least 2 in. in diameter.
3. Hydrometers with the greatest displacement and smallest diameter seem most reliable.
4. The stem is preferably graduated to read directly in dissolved solids.
5. The thermometer is preferably a part of the hydrometer, with graduations in terms of dissolved solids representing the value to be added or subtracted.
6. The hydrometer should preferably be calibrated at near room temperature.
7. All instruments should be kept clean and free from gas bubbles.
8. Density instruments meeting all listed requirements as to construction and use are sufficiently accurate for control purpose in regulating the concentration of dissolved solids in boiler water, but they should not be relied upon too much for precise results.

CAUSE AND PREVENTION OF TURBINE-BLADE DEPOSITS

BECAUSE solid deposits on turbine blades decrease capacity and efficiency, designers and operators are anxious to reduce carryover of solids in steam. Recently developed steam washers have reduced carryover.

This, however, is by no means the whole story of turbine-blade deposits, according to Prof. Frederick G. Straub, University of Illinois, who reported his experiments in the Tuesday Power session. Professor Straub found that soluble blade deposits (the only type he considered) are influenced as much by composition of the solid carryover as by its quantity. He seemed to prove that sodium hydroxide is the real culprit. The reason is that sodium hydroxide, even in superheated steam, is carried along as a sticky "solid solution" or paste, while other salts go through as a dry powder.

One set of experiments was made with steam containing substantial quantities of sodium hydroxide. This formed heavy deposits on the blades. When the sodium hydroxide was converted to the carbonate by adding carbon-dioxide gas before the superheater, the deposit disappeared, regardless of

the presence or absence of any other salts.

Sodium sulphate alone caused no deposit. A mixture of sodium hydroxide and sulphate (approximately 8 p.p.m. of sulphate and 4 of hydroxide) caused small deposits, but not as much as the sodium hydroxide alone. Yet when the sodium hydroxide was increased to 6 p.p.m., and the sulphate to 25 p.p.m., no deposit formed. Half the amount of hydroxide without sulphate caused a definite deposit. This appeared to indicate that sulphate was preventing the hydroxide from adhering. Tests made on actual plants confirmed the laboratory findings.

Among Professor Straub's conclusions were these: The amount of deposit is not proportional to the carryover from the boiler, but depends more upon the relationship among the various salts in the boiler water. Deposits increase mainly with the ratio of sodium hydroxide to other salts. Other salts reduce the deposits, probably because their dry powder coats the sticky mass of sodium hydroxide and prevents its adherence. Application of the inorganic salt treatment to one large central power plant increased the period of turbine washing from four to twelve weeks; it may be possible to eliminate the washing entirely. The cost of treatment has been less than $500 a year, and the savings substantial. Application of these data to plant operation should be made only under the control of a chemical engineer.

Discussion

Discussion of Professor Straub's paper brought out some differences of opinion. Glen B. Warren of General Electric suggested that experiments should not be confined to a single stage of the turbine. He had noted localized deposits in high-pressure turbines and thought it would be helpful if many power stations, including industrial plants with high make-up, would report their operating experiences to Professor Straub.

As a new slant on the problem, Mr. Michel of Siemens Schuckertwerke, Berlin, Germany, reminded the meeting that solid sodium hydroxide melts at 600 deg. F. Regardless of moisture, it will pass through superheater and upper turbine stages until it falls to this temperature. Another thing to remember is that a mixture with other salts may melt at a lower temperature. Benson boiler tests, he said, showed that deposits increase with temperature and pressure.

In a written discussion, C. R. Soderberg, manager of the Westinghouse turbine department, referred to Westinghouse data indicating that deposits increase with pressure and temperature, contrary to Professor Straub's conclusions.

Scaling, he said, is greatest at points of highest steam velocity. Turbine washing to remove soluble deposits becomes more risky with higher steam temperature. He hoped that steam purifiers between boiler and superheater will become standard practice.

A representative of the Dearborn Chemical Company approached the problem from a different angle, that of surface tension in the boiler water. It was important so to treat water, he said, as to reduce the effervescent, "ginger-ale," effect.

In his closure, Prof. Straub said that a complete report of his experiments will be published soon as an engineering bulletin of the University of Illinois.

FAN TESTING

Air-flow measurement and fan head discussed in two papers by those interested in preparation of fan test codes

MEASUREMENT OF AIR FLOW IN FAN-INLET OR DISCHARGE

IN MAKING tests of fans with inlet or discharge ducts, the volume of air to be measured varies from maximum to zero, the variation being obtained by changing restrictions on either the inlet or the discharge side of the fan. A critical survey of the various measurement methods available has led Lionel S. Marks to conclude that no one of the devices is satisfactory for the complete range of fan testing. The pitot tube will not give accurate indications at low fan capacity, nozzles and orifices will not permit the investigation of the fan with wide open discharge. As a result, he proposes to use pitot tubes for capacities near the wide-open condition and square-edge inlet or discharge orifices for lower capacity, down to the no-flow condition.

To make the pitot measurements accurate a standard form is suggested in the paper. The tube projected has an outside diameter of $\frac{5}{16}$ in. with a hemispherical tip. Static-pressure holes are 0.94 in. in diameter and $2\frac{1}{2}$ in. from the tip. The stem is 5 in. behind the static holes.

Coefficients of Ebaugh and Whitfield are suggested for use with inlet orifices and those of Stach are suggested for discharge orifices used with flange pressure taps on the approach side. The use of an impact tube with the discharge orifice is discussed.

Discussion

H. F. Hagan pointed out that in his experience performance of a fan near shut-off and at wide-open delivery was never required. He felt that before using the method suggested in the paper that collaboration should be obtained from other investigators and presented the results of tests which he had made comparing air flow measured with an old-style pitot tube, the type suggested in the paper, as compared with orifice and nozzle measurements. These results did not show very close agreement. In replying to this discussion, Professor Marks pointed out that all of the pitot-tube readings were higher than the values obtained from orifice and nozzle measurements. A. A. Criqui indicated that in his experience there have been some cases where performance at wide-open discharge was necessary. He pointed out that if tests were to be made using two types of measuring devices that two curves would be obtained that would not agree in the overlapping in proportion tested by both measuring devices.

DEFINITION OF THE QUANTITY HEAD CHARACTERISTICS

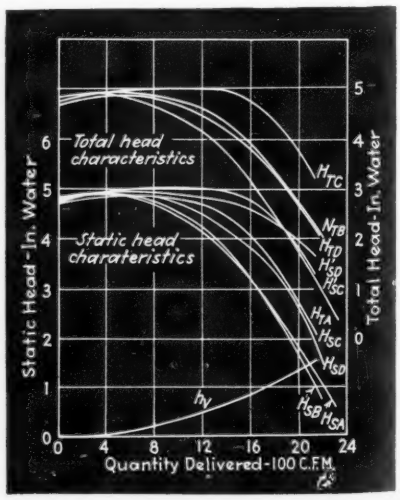
FAN characteristics are obtained to provide useful information regarding performance of a fan in its installation. M. C. Stuart and W. E. Somers, in "Quantity Head Characteristics of Fans," first discussed four basic arrangements of fan types and installations. These four arrangements are (a) bare fans, in which there are no ducts attached to the fans; (b) blower, in which the fan intake is from a large space or room, but discharges into a duct; (c) booster, in which the fan intake is through a length of duct and the discharge is also through a duct; and (d) exhauster, in which the intake is through an inlet duct and the air discharged into a large space. The authors show in the results of tests on a 9-in. diameter fan that different quantity head characteristics are obtained for each of these arrangements.

The authors also point out that there are currently used three fan head definitions, and indicate that the proper definition of fan head, as used in quantity head characteristics, is the discharge static head minus the inlet total head.

The quantity head characteristic curves obtained on tests of the 9-in. fan are illustrated below. These represent tests of the four different arrangements in which the total fan head, according to the three definitions is plotted against quantity of air delivered. If the recommended definitions for fan head are used, characteristics of the fan in all four arrangements are shown by the four lower curves.

Discussion

T. Baumeister, Jr., agreed with the author's definition of static heads and pointed out that suction head is really the friction loss in inlet ducts. A. A. Criqui remarked that fan manufacturers could not possibly give performance data on all fan arrangements. In reply to the discussion, Mr. Stuart indicated that it was not the intention of the paper to suggest that fan manufacturers give performance data for all different fan arrangements though this is important for axial fans.



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NEW MANAGERS

PRACTICAL

SELECTED FROM A.S.M.E.

"THERE IS nothing easy about boiler-water chemistry"—comment heard at the Feedwater Session. Easy to grant when we learn that the recent discovery of a little silicate in the sodium-hydroxide reagent used changes the conclusions of years of experimentation on "caustic embrittlement." It now appears that small quantities of silicate make all the difference in the world. However, the A.S.M.E. recommended sulphate-carbonate ratios still stand as sure way to prevent embrittlement until some more scientific method is proposed.

KINETIC ENERGY in the steam entering or leaving a turbine has always been neglected in tests to determine turbine efficiency. Use of impact pressure to take the kinetic energy of the steam into account has been suggested.

VISCOSITY is becoming an increasingly important engineering tool in fluid-flow and heat-transfer work. Knowledge of viscosity of water and steam has been extended to pressures of 3,500 lb. and temperatures of 1,000 deg.

A SURVEY of 7,284 industrial plants burning 19,634,266 tons of coal a year disclosed that 20.8% of the coal is burned on 8,878 hand-fired grates serving boilers having an average of 1,068 sq.ft. of heating surface. In these hand-fired installations there lies a great opportunity for plant improvement.

ZONED and metered automatic air control for underfeed stokers has been developed to a point which permits a 23% increase in peak fuel-burning capacity of the stoker. Thus, at Connors Creek Station the eventual expenditure of $250,000 for metered air control will save the investment of $1,500,000 in additional boilers.

COAL SO POOR it was impossible to burn on ordinary underfeed stokers is now being burned successfully on a newly developed water-cooled stoker. Ash from this coal runs out over the extension grates in a fluid stream. Water cooling has reduced power required to drive the stoker, eliminated trouble in distributing coal over the stoker and prevents burn-outs of stoker parts in the furnace.

A NEW DUST COLLECTOR makes use of eddy currents that in other designs have interfered with operation and decreased collection efficiency.

DIESELS, according to a study by Mr. Weinberg of the New York Central, will run a remarkably long time without attention. He feels that railroads have done an excessive amount of maintenance on their diesels, performing a detailed inspection every month or two when the engine is checked up. These engines are rarely loaded more than 40%, usually run 3,000 hours a year. Thus compared to stationary plants and their detailed inspections once in 10,000 operating hours, railroad engines should only be given detailed inspection once in three years. Several railroads are now doing this, and a number of engines have been operating three to four years without a head off or a piston pulled.

AIR WASHERS in air-conditioning systems will remove odors from food stuffs and body odors but will make tobacco smells worse. The only known ways to reduce the latter involve increasing the amount of fresh air supplied or the use of activated solids such as charcoal to adsorb the gas.

CREEP TESTS on heat-treated alloy steels, such as used for high-pressure, high-temperature steam work, have given results that vary as much as 3 to 1 from what was apparently the same kind of material. Research has shown that inconsistencies in these results are due to variations in grain size of the samples. Method of treating the steel, beginning with pouring it into the ingot mold, are being developed that will insure a homogenous structure and consistently high resistance to creep.

FOUR AIRFOIL-TYPE propeller blowers of special design ventilate the 165,000-kw. turbine-generator in Richmond station of Philadelphia Electric Co. These fans are motor driven at 3,550 r.p.m., and on test showed a maximum static efficiency of 78.5%. When these fans were designed, the development work was done on a quarter-size model. Results obtained with the model and full-size units checked very closely.

POINTERS

AND A.S.R.E. PAPERS

IT IS NOW KNOWN that study of cavitation has been established on a sound scientific and engineering basis, even though a large amount of work remains to be done before cavitation phenomena are completely understood. Tests made on model waterwheel runners check very closely with those obtained on the full-size unit, even when the large unit is ten or more times greater in diameter than the model.

IN GENERAL, efficiency and power of a diesel depend primarily upon the ignition delay of the fuel and the completeness with which it is distributed in the combustion space, the latter a problem of design, the former one of proper fuel selection. If fuel is prepared from selected crudes, no treatment of it is necessary. Since these crudes are largely those which are least desirable for the manufacture of gasoline, expansion of the use of diesels need not produce a serious drain on gasoline-engine fuel supplies.

WE MUST learn how to increase the well-being of the masses by producing more and more goods at lower cost. Here is a new frontier, a new field for American initiative. The automobile industry is a sample of what can be done.—Ralph Flanders.

METALLURGICAL studies made in a cavitation stand, where specimens can be subjected to accelerated cavitation effects, have shown the kinds of metals most resistant to cavitation. Results will probably be available next year.

IN LOW-HEAD HYDRO-ELECTRIC PLANTS using large propeller-type turbines, barometric pressure and water temperature may be important factors in determining the amount of load a given unit can carry without objectionable cavitation effects. Low barometric pressure and high water temperature both tend to increase cavitation. For periods of low barometric pressure in summer when water temperature is high, and of high barometric pressure in winter when the water is cold, the cavitation load limit may vary as much as 15%.

REFRIGERATION through pipelines suffered a serious setback when small electric units were developed, but two pipeline companies in Los Angeles and St. Louis report that widespread use of air conditioning has opened a field much larger than that lost. Instead of butcher shops and ice-cream parlors, the load is now office buildings, industrial plants, etc.

THERE SEEMS TO BE some disagreement between the results of laboratory experiments on turbine-blade deposits and the results obtained in plants. Early solution of this problem is very important, particularly for high-pressure plants with high makeup. It would seem very desirable that operators report their experiences to Prof. Straub of Illinois and to other experimentors, noting particularly the steam pressure and temperature and the location and character of deposits.

THUS FAR, steam stations have an advantage over a diesel plant of comparable size in that the steam engineer must be licensed, while the diesel engineer need not be. Were licensing required, chances would be better that the diesel would receive more expert operation and maintenance. Manufacturers have endeavored to minimize the effects of this difference by simplifying engine design and operation, by sealing in accessories, by avoiding designs which require close adjustment.

CLOSED WINDOWS are the major psychological factor fighting air conditioning. Imaginary colds, headaches, and odors all beclutter the well-being of the worker within the windows. Once the old idea that "open windows mean health" is knocked out of the average person's mind, acceptance of air conditioning will progress even faster.

COEFFICIENT OF FRICTION is outmoded these days. In design of high-speed diesels, the designer must consider friction torque, lubrication film, leakage factor, offset factor, and pressure of the film due (1) to pressure between the bearing surfaces, (2) to flow. Friction torque, which ends up by being the energy required to turn the crankshaft, rises steadily but slowly as long as that thin film of oil (something like 0.000001 to 0.000009) stays between the surfaces, but when it goes out and the metals come in contact, friction torque skyrockets.

HIGHLIGHTS
OF THE A.S.M.E. ANNUAL MEETING

AMERICA'S engineering capital is 29 West 39th St., New York, N. Y. There, for years, in the splendid building erected by Andrew Carnegie, the founder societies in civil, mechanical, electrical and mining engineering, have lived together.

Once each year, in the first week of December, the American Society of Mechanical Engineers stages its "old home week," in this building, filling the reception and meeting rooms with hundreds of its members from all over the country.

Through the years these meetings have acquired a distinct character. They vary, of course, from year to year, but you can always tell an A.S.M.E. annual meeting. If in no other way, you can tell it by certain familiar faces that are seen there year after year.

These affairs are complex in their ramifications. First, there are the practical or "kitchen" activities—many technical sessions with scores of papers on everything from power to occupational diseases, from applied mechanics to boiler feedwater.

This annual institution has also its "backyard fence," over which old engineering cronies exchange comments about their jobs, the weather, and the future of engineering. Graced by no official announcement, this chinning goes on day after day in lobbies, anterooms and everywhere the delegates meet and is a primary contribution of the annual meeting to the well-being of the engineering profession.

Finally, the annual meeting has its "front parlor" and its gaddings about town. "High-hat" front-parlor activities are typified by the annual dinner and those sessions where A.S.M.E. Bigwigs file onto the platform in dress clothes to award (and be awarded) medals for distinguished achievement. About-town activities are typified by engineering and sight-seeing excursions. Meanwhile the ladies have their own more or less serious-minded frolics and the men steal away to occasional smokers or reunions.

The accompanying pages sum up the high lights of the technical sessions from the angle of practical interest to POWER readers. This space is reserved for a few words about these other less prosaic activities of the 56th annual meeting, Dec. 2 to 6.

Of the 14,017 total membership of the A.S.M.E., approximately 2,100 attended the annual meeting. More than 280 sat down at the Metropolitan Section dinner to out-of-town members on Monday night. Entertainment included the singing of a superb quartet, in which C. E. Davies, A.S.M.E. secretary, participated, and a dramatic demonstration of gasoline and kerosene handling by Professor Allen of Worcester Tech.

Tuesday night a distinguished audience witnessed the conferring of honors and listened to the Thurston Lecture. Charles P. Bacha, of Rutgers University, and Robert W. Beal, of Oregon State College, won the student awards for papers dealing with stresses in metals and lubricating oils.

The Chas. T. Main award was won by G. Lowell Williams, of Lafayette College, for a transportation paper, and the Junior Award by Stanley J. Mikina, Research Engineer of Westinghouse Electric & Manufacturing Co., for his paper "Effect of Skewing and Pole Spacing on Magnetic Noise in Electrical Machinery."

Oscar R. Wikander of the Edgewater Steel Co., won the Melville Medal, and Prof. Stephen Timoshenko of the University of Michigan the Worcester Reed Warner Medal.

The highest award of the society, the A.S.M.E. Medal, went to Charles T. Main, one of Boston's most distinguished engineering citizens, for his achievements in textile and other industries, in engineering education, and for eminent service to the engineering profession.

Through all of these presentations Ralph Flanders, A.S.M.E. president, presided gracefully.

The meeting was then turned over to Past-President Roy Wright, who in turn called upon Dean Kimball of Cornell to cite Dr. William F. Durand for the greatest honor the engineering profession can render to one of its members, the John Fritz Medal, awarded by a joint committee of the A.S.C.E., A.I.M.E., A.S.M.E. and A.I.E.E. Dr. Durand, world-famed authority in hydrodynamics and aerodynamics, an outstanding leader in research and engineering education, responded to the award, which places his name with those of Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas Alva Edison, Ambrose Swasey, Elmer Sperry and Michael Pupin.

As a fitting conclusion of the evening, the Robert H. Thurston Lecture was presented by Charles H. Purcell, chief engineer of the San Francisco-Oakland Bay Bridge, who described this technical achievement.

At the annual dinner on Wednesday night, Ralph E. Flanders, retiring president of the A.S.M.E., delivered the eighth Towne Lecture, "New Pioneers on a New Frontier." Dean R. L. Sackett, of Penn State, was toastmaster. The dinner was followed by the president's reception and the annual dance.

As Towne lecturer at the dinner, Ralph Flanders concluded his distinguished term as A.S.M.E. president with an outstanding economic address on the subject "New Pioneers on a New Frontier." The old frontier, he said, gave youth its opportunity, capital its field, and enthusiastic individualism its solid foundation of fact. But that frontier is gone forever. No longer can dissatisfied young men of ambition push into an uninhabited American wilderness to hew out their own fortunes.

A new frontier, a new outlet for America's unparalleled energies, is at hand—the opportunity for a greatly raised standard of living for the masses, through "more and more goods and services at lower and lower prices in terms of income." Business men, industrialists, farmers and labor must give up the false belief that the best interests of each separate group are promoted by the restriction of output and by the controlling or raising of prices.

The second obstacle, he said, is the periodic onslaught of national speculative orgies. Both obstacles, he believed, can be overcome. The automobile industry, for example, prospered and served through real manufacturing competition, giving more and more car value for less money. Enough controls are now available to keep a stock market boom in hand, if the people demand it.

Throughout the annual meeting Dr. S. Marion Tucker, of Brooklyn Polytechnic, gave his lectures on "Talking With an Audience," which has proved so helpful and interesting in previous meetings.

Excursions included Radio City Music Hall, the turbine-electric Steamship "Peten" of the United Fruit Co., New York Edison East River Generating Station, Jacob Ruppert Brewery, Pullman Laundry, the new 39th St. Tunnel under the Hudson River, the S.S. "Santa Elena" of the Grace Line, the plant of the American Sugar Refining Co., Presbyterian Hospital, Medical Center, Hayden Planetarium, Ford Motor Co. at Edgewater, N. J., New York Telephone Co., Stevens Institute, Hunts Point Coke & Gas Plant.

This was off year for the Power Show, but the A.S.M.E. meeting was paralleled by meetings of the Federated Management Societies at the Hotel Astor and the American Society of Refrigerating Engineers in the Hotel Pennsylvania. Reports of some of the refrigerating sessions will be found on page 708.

NEW METHOD OF "GUESTIMATING"

DIESEL COSTS

OPERATING COSTS

GEORGE C. EATON of Edison Electric Illuminating Co. (Boston) presented "Oil-Engine Electric Generating Station Operating Costs," a study he made some months ago for a proposed diesel station of indeterminate size or output. His curves made no attempt to deal with fixed costs on invested plant, but limited themselves strictly to operating data. Six curves in the paper gave, in mills per net kw.-hr., annual fuel consumption, annual fuel cost, unit fuel cost, annual operating cost except fuel, total annual operating cost and total unit operating cost, all related to capacity factor. Data used covered 323 station-years of operation in plants varying from 1,000 to 15,640 installed brake horsepower, but the author felt that they could safely be extrapolated for plants up to 30,000 hp.

Mr. Eaton made no attempt to correct for type of engine, method of fuel injection, scavenging, heat content of fuel, altitude, locality, etc., but confined his study purely to known data.

Discussion

Edgar Kates questioned whether the curves were of any practical value, since he felt that the basis used (capacity factor) was not as sound as running load factor. As an example he mentioned the inherently better load factor of a 1,000-kw. plant with five 200-kw. units than with two 500-kw. units, due to greater flexibility. He felt that it is better, in considering a diesel plant, to get data from comparable modern plants rather than to use averages which cover a very wide range of types and conditions.

Prof. Schweitzer of Penn State College announced that Penn State plans to figure out the correlation coefficients for various factors, thus making an effort to discover just which factors are sufficiently correlated to justify their mutual use in charts.

Harry C. Major, Commissioner of Public Utilities at Rockville Center, L. I., explained that the annual Oil Engine Operating Costs Report covers both well and poorly managed plants, and since something over 150 plants are included, it is much more practical to select typical plants operating under similar loads and of similar sizes as a proposed plant to use as a basis for forecasting.

M. C. Reed of the Diesel Engine Manufacturers' Association explained that Mr. Eaton's curves certainly should be of value in the first rough approximation to discover whether or not a diesel plant is at all suited to the particular conditions, and then if found a possibility, more detailed studies can be made.

Lee Schneitter of Electric Bond & Share felt also that the curves were of value for rough approximation, but of little value in detailed comparison because the time considered by Mr. Eaton (5 yr.) was too short. This is particularly true because the period involved covers a depression, when much excess capacity is installed and maintenance is deferred. It was also discovered that Mr. Eaton had made an error in figuring capacity factor which would shift his curves to increase unit prices slightly.

Mr. Yates remarked that Mr. Eaton had attempted an almost impossible job, Harte Cooke that the curves might help an operator determine whether his plant was as good as average, particularly if his plant includes several different engine sizes. He felt also that newer diesel plants would show better results.

Mr. Weinberg, of the New York Central Railroad, explained that a recent study of his had shown that a diesel will run a remarkably long time without maintenance. It is his feeling that railroads do too much maintenance on their diesels, since the engines do not operate at more than 40% load most of the time or more than 3000 hours a year. He mentioned several examples of railroad diesels which are running three to four years without major repair, pulling of cylinder heads, etc.

In his summation, Mr. Eaton explained again that his curves were of necessity very general, since at the time of his study he did not know what the size of the proposed plant was nor its annual loading, except that it would be of a size somewhere between 15,000 and 30,000 kw. It was planned to supplement the existing system of his company in a heavily loaded area.

LUBRICATION THEORY AND BEARING DESIGN

E. S. DENNISON of Electric Boat Co. presented "Film-Lubrication Theory and Engine-Bearing Design." He explained that though this subject had been extensively covered, it had not been covered from the particular angle which he had chosen—that of a limited-length cylindrical bearing with a circumferential groove. He considered leakage factors and offset bearing factors in his calculations also. Both his results and the discussion were of interest primarily to diesel designers, hence are not included herewith. The full reprint of his paper and the discussion will, however, be available from the Society.

IGNITION AND COMBUSTION OF DIESEL FUELS

MR. LEE, of Shell Petroleum presented the exchange paper, "Ignition and Combustion of Diesel Fuels" by G. D. Boerlage and J. J. Broeze, of Delft, Holland, who are connected with Shell's Dutch affiliate. Their conclusions were:

Pressure diagrams show that, following the injection of fuel into an engine, there is a delay prior to the main pressure rise. This delay has been described as a warming-up period during which the temperature of the fuel is approaching that required for a flame to start. However, closer inspection of the diagram indicates that not only does the pressure often decrease at first, suggesting the absorption of heat resulting possibly from vaporization or decomposition, but that it may then increase by as much as several atmospheres before the rapid combustion sets in. Therefore, the authors prefer to conceive of the delay time as an active period during which reactions occur which develop heat. As soon as the temperature at some point becomes sufficiently high the flame starts, which follows the laws of flame combustion, e.g., acceleration by whirling, by Ricardo.

This second period is one of uncontrolled combustion and is followed by a third period during which the combustion is controlled by the rate of fuel injection. With slow-speed engines in which the delay period is short compared with the total time of fuel injection, the combustion curve has a smooth character, however, with high-speed engines, the first and second periods become more distinct.

The authors' diagrams show that incrustation of the atomizer may have greater effect on the final period than the deterioration of the spray resulting from excessive viscosity. Although the atomization of residue oil was improved by preheating, the atomizer became incrusted, causing less-efficient combustion.

In general, the efficiency and power of an engine depend primarily on the ignition delay of the fuel and the completeness with which it is distributed within the combustion space. The latter is chiefly a design problem; the former is dependent upon the type and treatment of the fuel. While poor fuels can be improved by mixture with dopes such as peroxides or nitrates, such treatment is expensive and can generally be dispensed with if the fuel is prepared from selected crudes. Since these crudes are in general the ones which are least desirable for the manufacture of gasoline, the expansion of the use of diesel engines really need not produce a serious drain on the available supplies of fuels for gasoline engines.

Discussion

PROF. SCHWEITZER thought the authors' figures on ignition delay were low, due to his own experiments, but explained that accurate figures were difficult to get. Penn State had to use an oscillograph or similar apparatus. He pointed out that one figure indicated cetene number as proportional to percentage of cetene in mixtures, thus a large percentage of cetene is necessary for any worthwhile effect. Hence dopes would be of little value, although one of the authors' tables contradicts this.

Ralph Miller questioned whether crudes most desirable for diesel fuels are least desirable for gasoline. One oil man didn't entirely agree with the authors, but said some crudes not suitable for gasoline did yield poor-grade gas oils. The authors' representative corrobated this. He felt that the authors' ignition-delay figures were correct.

RESEARCH

ENGINEERS with long memories may recall that now-distant day when practical men looked with disdain on scientific research. Since then we have moved far. Pick up the program of the A.S.M.E. meeting, or that of almost any other engineering society, and you will find it packed with research papers.

The conviction grows on one that scientific research is reaching the same place in American life that it achieved years ago in Germany. All of this, of course, means rapid national and industrial progress. At the same time it is raising certain problems which vitally affect the operations of technical societies and which will themselves demand a little research before long.

When the A.S.M.E. member engaged in practical engineering work attends one of these sessions and hears a paper which is unintelligible to him and probably to 95% of the membership, he may ask "what good is a train that never reaches its destination?" The purpose of printed papers and speeches, presumably, is to transmit ideas to an appreciable number of people. This very obviously is not accomplished by the average research paper.

On the other hand, it must be recognized that a profound and mathematical analysis of the stresses in a helical spring, or of the radiation from luminous particles in a gas may be of tremendous value to a dozen or so investigators and designers, and that these few specialists, in turn, may use it in designing new equipment of greater productivity, longer life and lower cost.

It would appear, then, that engineering societies should seriously consider how they may get important research on the records and how they may transmit it to the men who can use it, without wasting tons of paper and thousands of man-hours of time in shipping 99% of the valuable product to the wrong destination.

It seems to the writer, who is an enthusiastic supporter of research, that profound research papers have perhaps been given too much time and space in recent A.S.M.E. meetings, that the meetings should be devoted more largely to the discussion of matters from which the average member can personally profit.

It should be made perfectly clear that this criticism is in no sense directed at the subject matter of the research itself. It is merely felt that a small fraction of the brainpower now being devoted to research should be applied to a common-sense study of the appalling waste in our national transportation system for research ideas.

Getting to the A.S.M.E. research papers themselves, many of them, but probably not all, were worthwhile contributions to knowledge. Final decision on this point will have to be made by the men who try to use them. For their assistance we shall list the subjects and authors, but attempt no abstracts. That would be impossible in the space available, and of practically no use to the majority of readers.

It is interesting to note that three whole sessions of the Annual Meeting were devoted to a single subject—Radiant Heat. Two carried that actual title, while the other was headed "Boiler Furnaces."

Readers interested in the original papers of the boiler-furnace session are referred to the November, 1935, number of *A.S.M.E. Transactions*, Vol. 57, No. 8.

First is the paper, "Evaluation of Effective Radiant Heating Surface and Application of the Stefan-Boltzman Law to Heat Absorption in Boiler Furnaces," by H. F. Mullikin, Research Fellow, Superheater Co.—Yale University Fellowship. This 12-page paper presents a method of computing the equivalent effective radiant heating surface of a boiler, taking account of spacing of the water-wall tubes, construction, slag coatings, emissivity, etc.

"Review of Methods of Computing Heat Absorption in Boiler Furnaces," by W. J. Wohlenberg, professsor of mechanical engineering, Yale University, and by H. F. Mullikin, is a critical comparison of the results obtained by various methods of calculation, including actual measurement, the Broido method, the Orrok method, the Wohlenberg method.

"An Experimental Investigation of Heat Absorption in Boiler Furnaces," by W. J. Wohlenberg, H. F. Mullikin, W. H. Armacost (Superheater Co.) and C. W. Gordon. This is a report of the A.S.M.E. Committee on Absorption of Radiant Heat in Boiler Furnaces, and includes the analysis of test data on ten boilers in different power plants in the United States. It involves stoker-fired, pulverized fuel- and oil- and gas-fired units, with various combinations of refractory and water-cooled furnaces. A notable feature is the measurement of furnace exit-gas temperatures by means of the high-velocity thermocouple.

Following are the papers presented in the two sessions on radiant heat:

"Radiation from Non-Luminous Flames," by H. T. Hottel and V. C. Smith. Carbon monoxide and illuminating-gas flames were measured at various burner lengths and air-gas ratios. Results are compared with published carbon-dioxide radiation charts.

"Tests of Radiation from Luminous Flames," by W. Trinks and J. D. Keller. Tests were made on burning natural gas in highly preheated air, with various burner arrangements and proportions, including excess gas or air, pressure and velocity of gas, port design, etc.

"Emissivities of Refractory Materials," by R. H. Heilman. Effect of temperature, color and nature of surface. Emissivity curves for refractory materials, high-temperature paints and enamels. Discussion of economies.

"A Radiometric and Pyrometric Study of Diffusion Flames," by M. A. Cooper and H. C. Hottel. Presents map of radiating intensity of a diffusion flame with true temperature measurements by two methods. Two-color optical pyrometer predicts values.

"Radiation from Pre-Mixing Burner Flames in Combustion Chambers," by E. O. Mattocks.

"A Study of Methods for Measuring Flame Temperature in an Internal Combustion Engine," by A. Hershey. Methods used in determining temperature of gases under steady load. Radiation and spectral line reverse methods considered and compared.

INDUSTRIAL POWER

AS HAS generally been true in recent years, the A.S.M.E. Annual Meeting gave practically no attention to problems specific to the industrial power plant, although, of course, many of the papers dealt with matters of interest to power men in industry.

For several years a group of engineers specifically interested in industrial power problems have met for luncheon and an afternoon conference at the Midston House, Madison Ave. at 48th St. This informal luncheon conference, while not officially a part of the A.S.M.E. program, is made up almost entirely of A.S.M.E. members and is always held in connection with the Annual Meeting.

The report of the Power-plant Betterment Committee was presented by Julius Berger, its chairman, and that of the Power Cost Committee by its secretary, Philip W. Swain. For the coming year it was decided to merge the two committees, with Alfred Vaksdal, plant engineer of Corning Glass Works, as chairman. It is expected that the work of this consolidated committee will include the gathering of data on unit maintenance costs for pulverizers, stokers and other power equipment. Practical tests may also be made with the forms previously developed by the Power Cost Committee for the interchange of data on cost of making steam and electricity.

Next year's general chairman of the luncheon conference was not elected at the meeting, but will be later by letter ballot of the executive committee.

Aside from business, the feature of the session was an intensely practical talk on maintenance by Mr. Vaksdal. It is a basic mistake, he said, to let maintenance run itself. It must be managed. As proof of the large savings that can be made, he displayed charts showing the continued and rapid fall of maintenance costs in the Corning Glass plant. Savings in the consumption of electricity, water, compressed air, etc., were equally striking, amounting in all to about $30,000.

Correct maintenance, Mr. Vaksdal declared, will practically eliminate breakdowns. In most cases, he said, it will be necessary for the plant engineer to build up his own maintenance cost system, as any developed for this purpose by the factory cost department will generally be of little value.

The discussion, to some extent, centered around the desirability of having a separate maintenance card for each machine. Most of the conferees agreed that, except in the case of very large and expensive machines, this is an unwarranted complication.

A MODERN DUST COLLECTOR

A PAPER by Herman Van Tongeren, of Holland, read by Stanley Brown, discussed results of a study of principles governing design and operation of modern dust collectors. While 100% total collection efficiency is the aim of every designer, this ideal can only be closely approached. In the case of a dust collector for removing dust from combustion gas of boilers, the nuisance factor is considered, and the design and merit of the collector are determined by its ability to remove as nearly as possible 100% of the particle sizes which come within the range of the nuisance factor. Within city limits, particles of 30 microns and above can be considered as creating the nuisance.

The study deals with dry dust collectors of two types, namely, a compound or so-called chimney type, and the cyclone type. The first comprises a primary collector or concentrator coupled to a secondary or cyclone collector, while the latter type covers a single or multiple installation of cyclones handling dust-laden gas directly without primary concentrators.

The theory usually employed in the design of centrifugal dust collectors is based on the assumption that the dust particles in entraining gas flow parallel to the walls of the collector-case bend. This theory does not hold good in practice, as the gas velocities in a centrifugal dust collector always lie above the critical velocity between parallel and turbulent flow. Turbulence is not the only factor to be considered. One which is more detrimental to good collection, unless harnessed in the proper manner, is the double-eddy current." These secondary whirls are set up by the main flow and are in opposite directions at the top and bottom of the duct, so that midway between top and bottom the direction of both currents is toward the outer edge of the curved surface.

The secondary double-eddy current builds up in definite zones heavy concentrations of dust in ring formation in which the dust is no longer carried in free suspension, but moves in heavy concentration through a circular path governed by the double-eddy current. An important feature of the double-eddy current, which hitherto has not been taken into account in the design of dust collectors, is that the velocity of the fine particles of dust derived from the component of a double-eddy current is many times greater than the velocity impressed upon them by the centrifugal force.

The paper shows the design developed, which takes advantage of the double-eddy current. In the primary or concentrating element of the chimney type collector the dust concentration due to double-eddy current is at the top and bottom of the concentrator, consequently a scoop is arranged to remove the dust-laden gas from this portion. Vanes were developed for the central portion of the concentrator through which the main flow of clean gas escapes. The vanes do not extend to the top and bottom of the concentrator, but only in that portion where the double-eddy current removes the dust particles away from these exhaust vanes.

In the case of the cyclone separator, the double-eddy currents cause a concentration at the top of the cyclone. A scoop was introduced at the top of the cyclone to remove this concentration of dust, which is by-passed to the lower portion of the cyclone, being introduced where the velocity of the gas is in a downward direction.

Curves in the paper show that with this newly developed type of dust separator, efficiencies of 95% are obtained with particle sizes of 30 microns, and 90% with particle sizes of 20 microns.

Discussion

Discussion brought out that the velocity of the gas entering the dust collector is usually designed for 62 ft. per sec. The dust discharge from the bottom of the secondary or cyclone separator should be sealed to prevent any leakage of air.

Melvin Engle questioned the statement by the author that dust particles of 30 microns did not constitute a nuisance.

In response to questions concerning erosion, Mr. Brown replied that one set of dust collectors had been in service for five years and that there had been no complaints from erosion, another set had been in for three years with one complaint of erosion at a welded joint.

CREEP OF METALS

Creep and its effects discussed in four papers in one session and an additional paper in a Power Session. One paper presents a possible basic law for creep; another shows that heat-treating and uniform steel control creep

FOUR papers on creep were presented in a joint session of the Applied Mechanics and Iron and Steel Divisions, and a fifth at one of the Power Session meetings.

DESIGN ASPECT OF CREEP

R. W. BAILEY, of Metropolitan Vickers Electric Co., Manchester, England, presented an exchange paper on design aspects of creep, showing the application of a general formula to thick cylinders, pipes and tubes with and without heat flow, and to centrifugally loaded parts such as turbine disks. He also discussed the effect of bending and twisting moments on pipes under fluid pressure.

ANALYZING DATA

THERE is evidence of a basic law of creep, or so experiments by R. G. Sturm, C. Dumont and F. M. Howell of Aluminum Company of America would indicate. In "A Method of Analyzing Creep Data," they presented evidence of a possible law, and indicated the effects of composition, rate of strain hardening, temperature, and some manufacturing processes, including heat-treatment, on various materials.

SPECIAL CASES

A. NADAI and E. A. Davis of Westinghouse Electric & Manufacturing Co., in "The Creep of Metals," explained the condition necessary for existence of a stress surface. They then worked out several special cases of creep under simple assumptions as to the effects of strain hardening and of velocity of deformation on the rate of creep of a part of a structure.

RESIDUAL STRESSES

C. G. ANDERSON of the University of Michigan, in "Residual Stresses in Cold-Drawn Brass Tubes," listed various methods of determining residual stresses in tubes and gave a detailed description of the apparatus necessary for the work. He showed how stresses may be reduced by various different methods of annealing tubes.

CREEP OF STEEL

DEMANDS for higher efficiency in turbines, boiler and other equipment necessitate high temperatures and pressures. To meet these conditions requires materials that can resist a stress of 30,000 lb. per sq.in. and 842 deg. F., without showing a total dimensional change, or creep, of more than one mil per inch, or 0.1%, at the end of more than 10 years. Experience has shown that alloy steels must be used for these purposes. These must not only have proper chemical composition and be heat-treated, but they must be structurally uniform. The latter has been shown of vital importance by creep tests conducted by the General Electric Co., results of which were presented in "The Creep of Steels as Influenced by Macrostructure," by L. L. Wyman, at one of the Power sessions.

Although experiments on severely banded steel, with a creep strength as low as 12,500 lb. per sq.in., disclosed that it could be heat-treated to give result three times as high at 842 deg. F., the answer to the problem is not entirely heat-treating. A structurally uniform steel is required to start with. Experiment with controlling ingot temperatures while cooling in the mold and afterward a moderate amount of forging give promise of creep test result of 35,000 lb. per sq.in. at high temperatures.

AIR CONDITIONING AT

A.S.R.E. MEETING

AIR CONDITIONING was the theme of the 31st annual meeting of the American Society of Refrigerating Engineers held in the Hotel Pennsylvania, New York, December 4 to 6. Among the papers presented, probably the one of greatest interest to power operating engineers was that on "Rational Application Procedure in Selecting Air-Conditioning Equipment," by F. H. Faust and F. O. Urban, of the General Electric Co.

Basic requirements of an air-conditioning system, according to the paper are capacity, arrangement and control to meet application standards and specified conditions with a minimum total cost. Steps suggested for the procedure include (1) survey of proposed undertaking, (2) calculation of heating and cooling load, (3) selection of type of system, and (4) selection of equipment. Various forms were shown which expedite collection of survey data. Selection of the system involves numerous possibilities, such as unit systems, central plant systems and various zoning arrangements.

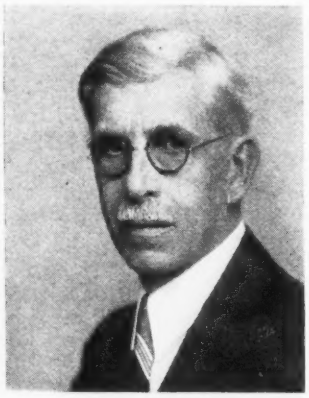
The selection of equipment involves balancing the combination of heat transfer surface and temperature of cooling medium to get the lowest possible overall cost. Another important factor is the relation between quantity and temperature of air delivered from the air conditioner and the method of introducing it to the conditioned space. Dehumidification may be accomplished by passing air over a heat transfer surface or through a spray of water which is maintained at a temperature of below the initial dew point of the air. The problem is to so select the surface and its temperature that dehumidification and sensible heat absorption will be in the right proportion to just offset the moisture and sensible heat gains. For these calculations the psychrometric chart is an indispensable tool. The authors presented a series of curves showing how the action takes place along a series of lines on the psychrometric chart and how many of the required values may be taken right off the graph.

Equipment Selection

Refrigeration equipment is selected on the basis of the total cooling load and the required cooling medium temperature. The first point to consider is an economic balance between air quantity and heat transfer surface, together with a careful consideration of the effect of air temperature and quantity on the method of introducing it to the conditioned space. Although the total cost of an air-conditioning system may be reduced by slight variations in design indoor conditions, these are beyond the control of the application engineer in industrial and process applications, and often in comfort applications. Air flow and characteristics of heat transfer surface are the only variables.

Both spray type and surface type equipment have definite limitations as regards dehumidification. Once the entering air point is fixed, maximum ratio of latent to sensible capacity attainable with either type of equipment is fixed by the steepest line which may be drawn through the initial point and terminated on the saturation curve of the psychrometric chart, tangent to the curve.

Factors involved in the selection of equipment are relation of air quantity to heat transfer surface, relation of air quantity and heat transfer surface to cooling medium temperature, relation of cooling medium temperature to capacity of refrigeration equipment, relation of air quantity to air distribution system, and relation of quantity and temperature of treated air to air motion and temperature distribution within the conditioned space.



L. S. MORSE
York Ice Machinery Corp.
New President, A.S.R.E.

In the discussion that followed the lecture it was brought out that the migration of moisture through cracks of walls and diffusion of moisture from bodies of air to fin surfaces have never been adequately measured. There is a great need for experimental research to obtain empirical values for certain materials.

Fan Problems

In "Fan Selection and Nomenclature," A. A. Berestneff, research engineer for Carrier Engineering Co., said that the basic concepts of fan performance and characteristics are often poorly understood. Every engineer has to build his own concept of the subject and use his own judgment in applying available performance data.

The most important characteristics involved in fan selection are total and static heads developed in terms of total, static and velocity pressures as applied to air flow at the inlet and outlet. The difference in total pressure at fan outlet and inlet is called "fan total pressure." Mr. Berestneff believes that the fan should be credited with both the velocity pressure and the static pressure.

Odor Control

"Control of Odors in Air Conditioning," by Philip Drinker, Harvard School of Public Health, showed that the absolute quantity of vapors which cause significant odors is very small. Concentrations are usually in the order of parts per billion by volume. Three kinds of odors to be controlled are from (1) food and waste products, (2) body odors and (3) tobacco odors.

Odor control can be accomplished by one of four methods, (1) absorption or condensation in cold water or ice, (2) dilution with clean air, (3) adsorption on activated solids, and (4) oxidation.

The control selected depends on the particular odor which must be overcome, the type of installation, and the conditions imposed by the installation.

Freon Compressors

"Data from Experiment and Research Preceding the Construction of Large Freon Compressors," by Llewellyn Williams, York Ice Machinery Corp., indicated that ammonia compressors can operate with Freon, but would use a large amount of its indicated power to induce and discharge gas from the cylinder. There would be excessive leakage past the valves during compression, and noisy valves. Hence, a good ammonia compressor cannot be expected to pump Freon economically at the standard speed of the ammonia compressor. Changes made to adopt compressors to Freon include larger and more carefully streamlined gas passages, increased speed, and larger diameter cylinders.

Propose Standard

Proposed "Standard Method of Rating and Testing Air-Conditioning Equipment," by a joint committee of the A.S.R.E., A.S.H.V.E., A.C.M.A., R.M.A., and N.E.M.A., prescribes methods of rating and testing air-conditioning and air-treating units of forced convection type. Copies are available from American Society of Refrigerating Engineers, 37 West 39th St., New York, N. Y., at 20 cents each.

Piping Cold

"Pipe Line Operation and Application," by Nels H. Rosberg and read by Herbert C. Guile, indicated some operating problems and the construction of the Los Angeles system.

In laying a new line the pavement is cut 18 in. wide and as deep as desired, with the side walls tapering outward to give an ultimate bottom width of 3 ft. The lower half of a cement tile conduit is then placed in the ditch. Pipe supports with porcelain rollers are placed on 10 to 12-ft. centers inside the tiling, and liquid and suction pipe lines laid on the rollers. The lines are then welded. No insulation is used on underground suction gas lines, as a superheat of 35 to 45 deg. is maintained. A semi-circular cement cover is used.

Review of

POWER and MECHANICAL EQUIPMENT

In the pages that follow **Power** presents its eighth annual review of new and improved equipment. The 409 descriptions here presented are summaries of those which have appeared in **Power** since January, 1935, supplemented by some 30 items not described during the year but received on our special request to make this review complete.

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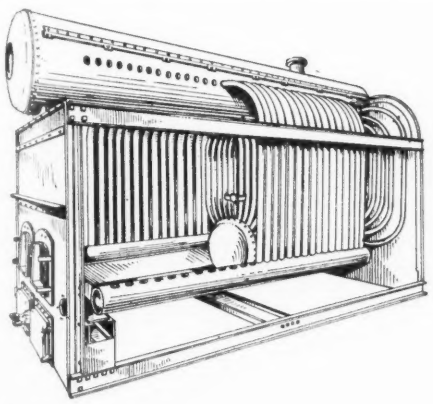
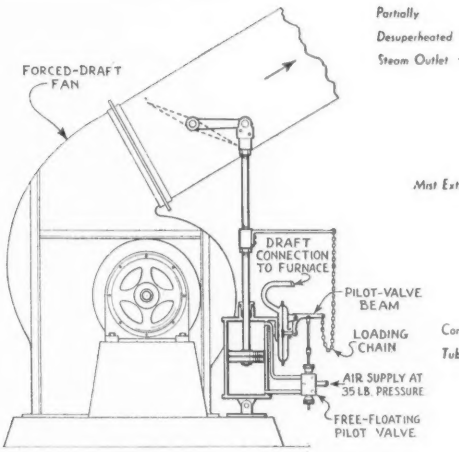
BOILERS, REFRACTORIES AND ACCESSORIES





Water-Tube Boiler

TYPE "CP," completely steel-encased and insulated, has no brickwork except for front and bridge walls. Water-cooled furnace sides and built-in soot blower. Sizes to 2,500 sq.ft., pressures 450 lb. Top ends of waterwall tubes discharge directly into upper drum. Lower ends terminate in headers extending from front to rear. Rear ends of headers are connected to rear end of lower drum by means of circulating tubes.—*E. Keeler Co., Williamsport, Pa.*

Smoke Indicators

"ECLIPSE" periscope-visual smoke indicator consists of stereopticon light unit on one side of breeching or smoke pass, throwing light through window sleeve on other side into periscope, then down to vision unit. May also be equipped with light-sensitive relay actuating alarm bell, smoke density meter or recorder.—*T. W. McNeill Eng. Equip. Co., 4057 West Van Buren St., Chicago, Ill.*

Refractory Concrete

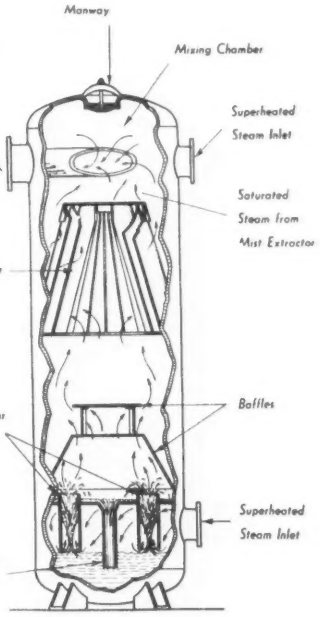
"INSULCRETE" for poured furnace linings and other industrial uses. Heat storage less than half that of firebrick, heat resistance to 2,500 deg. F., low permeability, negligible shrinkage and expansion. Weight 60 lb. per cu.ft.—*Quigley Co., Inc., 56 West 45th St., New York, N. Y.*

Draft Controller

SELF-CONTAINED furnace-draft controller requires only connection to furnace and supply of compressed air at approximately 35 lb. Measures furnace draft by large diaphragm, which actuates air pilot valve admitting pressure to one end or other of drive cylinder until damper position or fan speed has been changed to restore furnace draft to desired value.—*Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.*

Cabinet-Type Steel Meter Panel

DOORS protect and conceal meter and control connections. Door panels 1-piece sheet steel. Self-supporting. Base flange drilled for molding or lagging, if desired. Flange may be concealed within cabinet by bending both front and wings inward to 90-deg. angle. Black finish looks like slate or composition.—*Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio.*

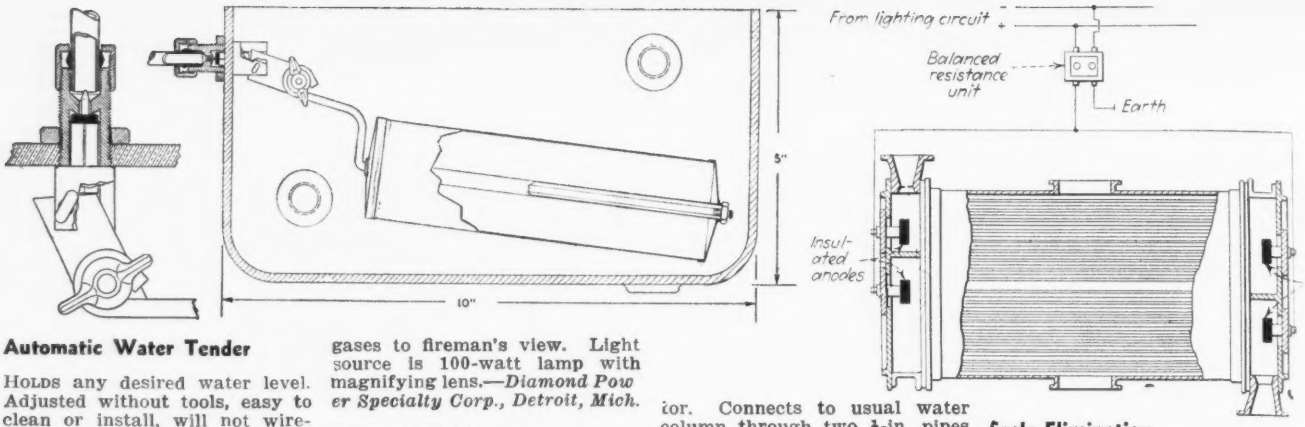


Desuperheater

REMOVES superheat in steam by flooding with water. Carryover of water prevented by separation equipment. Also acts as purifier. Steam leaving is dry and saturated. Does not require balance between water input and steam.—*Blaw-Knox Co., Pittsburgh, Pa.*

Water Treatment

"BIRM" granular filter medium used in pressure or gravity filter to remove iron and manganese from water supplies is regenerated simply by backwash without chemicals. — *C. F. Burgess Laboratories, Inc., Madison, Wis.*



Automatic Water Tender

HOLDS any desired water level. Adjusted without tools, easy to clean or install, will not wire-draw, stick, splash or chatter. Unit shown with narrow balance tank, only 3¾x5x10-in. over-all. —*Humidity Headquarters, 1893 East 55th St., Cleveland, Ohio.*

Colorimetric Testing Kits

TESTS for silica, phosphate, oxygen and pH. Solutions contained in small pipette-stoppered bottles. Extra solutions with each kit. Separate cases for oxygen or pH, while silica and phosphate kits may be combined.—*National Aluminate Corp., 6215 West 66th Place, Chicago.*

gases to fireman's view. Light source is 100-watt lamp with magnifying lens.—*Diamond Power Specialty Corp., Detroit, Mich.*

Suspended Refractory Arches and Walls

ABOUT half size of T-slotted tile, and with corrugated or treaded faces which match together. Smaller tile reduces spalling. Intermeshed faces eliminate working through of furnace gases or flames, and prevent air from leaking into furnace. Joint material is so locked that it cannot become loose or fall out. Called "Detred." Fits existing Detrick installations without changing iron parts.—*M. H. Detrick Co., 140 S. Dearborn St., Chicago, Ill.*

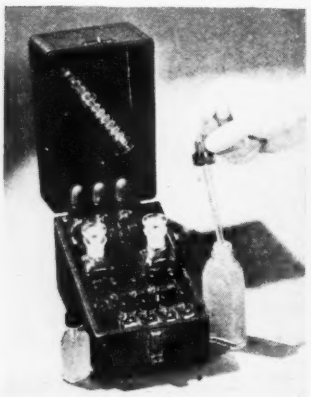
tor. Connects to usual water column through two ½-in. pipes for up to 300 lb. pressure and ¾-in. pipe up to 2,000 lb. pressure. May be mounted any distance from boiler.—*T. W. McNeill Eng. Equip. Co., 4057 West Van Buren St., Chicago, Ill.*

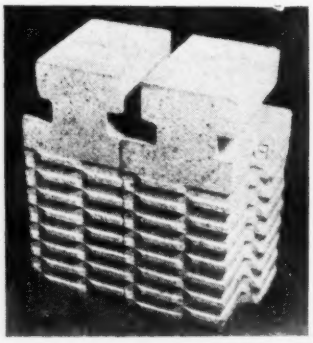
Insulating Bricks

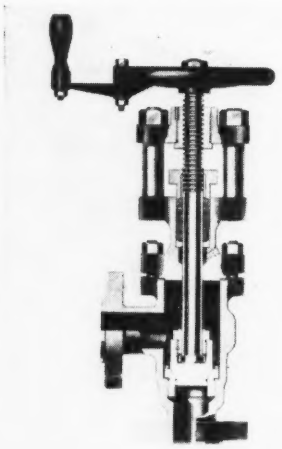
EF-26 insulating firebrick for direct exposure up to 2,600 deg. requires no firebrick protection except when exposed to flame or slagging action. M-20 insulating brick for use where temperature back of refractory does not exceed 2,000 deg. on hot face of brick.—*Armstrong Cork Products Co., Lancaster, Pa.*

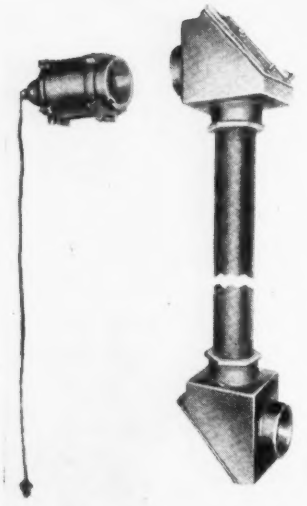
Scale Elimination

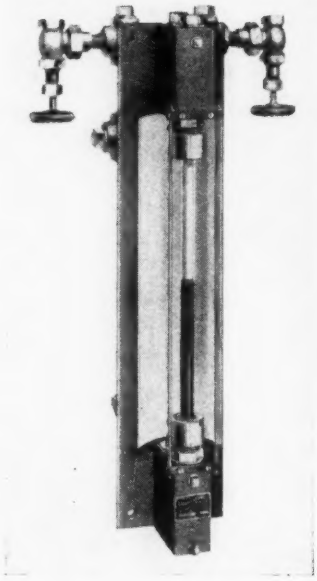
CUMBERLAND system works electrically without boiler compound, feedwater treatments, water softeners or similar agents. Anodes connected to positive pole or electrical energy source are immersed in water, each set being controlled by separate set of balanced resistance units. Rotary transformer or small motor-generator provides d.c. at 10 volts and 10 amps. Shell and tubes serve as negative pole. Anodes gradually destroyed, and protective hydrogen film built up on interior surfaces of unit. —*Niagara Combustion Corp., Niagara Falls, N. Y.*











Smoke Indicators

LIGHT source shines through boiler uptake into series of mirrors which direct image of flue

Boiler-Water Level Indicator

BLACK indicating fluid on curved white background, is used in this remote-water boiler-level indica-

Light-Weight Refractory

"FIRECRETE" is chiefly high-alumina clay calcined at high temperatures. Weighs only 75 lb. per cu.ft. and has negligible shrinkage at 2,400 deg. F. Withstands severe alternate heating and cooling, 40% lighter than fire brick and 40% lower in heat-storage capacity. Reduced radiation losses. For shapes and furnace doors and floors. —*Johns-Manville, 22 East 40th St., New York, N. Y.*

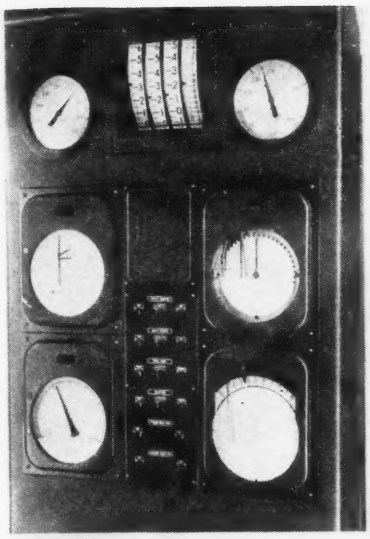
Blow-Off Valve

FORGED steel, hardseat. Two pressure ranges, 600 and 1,500 lb. Seat and disk type, with inlet under seat. Body is flanged steel forging of angle pattern with side outlet. Stainless steel seat ring and disk. Lip on lower end of disk checks wire-drawing and protects bearing faces. When valve is opened, top of disk nut seats against bottom of bonnet, permitting repacking under pressure. — *Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.*

Header Protection

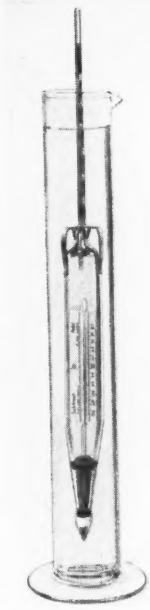
SINGLE belt of supported wall for protecting lower portions of headers and ends of tubes on straight-tube water-tube boilers. Panel-supporting castings bolted to drip pan which acts as horizontal frame member. Drip pan can be connected to boiler column. Protection independent of balance of wall.—*Geo. P. Reintjes Co., 2517 Jefferson St., Kansas City, Mo.*

sets of spring prongs readily detached for cleaning.—*Permutit Co., 330 West 42nd St., New York, N. Y.*



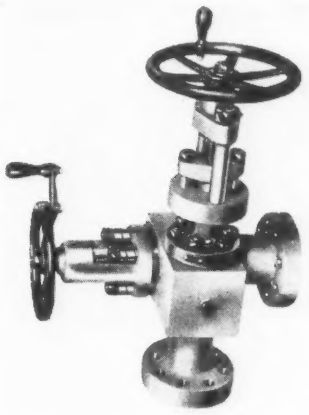
Combustion Control

INSTRUMENT and control panel provides indicating, recording and integrating meters and combustion - control equipment with provision for selecting automatic operation or manual control of any part of system. No open contacts or relays. Air, water, oil or electricity may be used as transfer medium. Adjustments of relationships of oiler loadings, air-fuel ratio and pressure or draft settings made on panel. Any combination of instruments and controls may be assembled to meet individual plant requirements. Usual assembly is: indicating, pressure and draft gages; indicating, recording and integrating steam and water meters; and indicating and recording CO_2, draft, pressure, temperature and water level. — *Hays-Carrick-Cochrane, P.O. Box 299, Michigan City, Ind.*



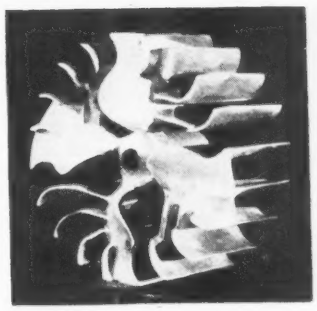
Hydrometer

FOR control of boiler salines and other applications, automatic compensating "Pacometer" calibrated for quick reading has self-contained thermometric correction scale in bulb. Stem highly polished metal, with scale readings etched. Metal stem attached to glass bulb by two



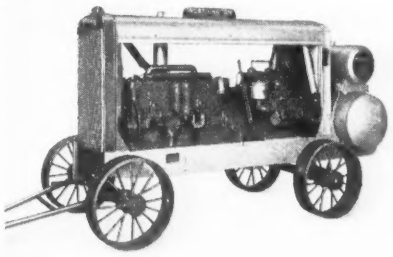
Forged-Steel Tandem Blowoff Valve for H.P.

1-PIECE forged steel billet is common body for both valves, with flanged forged-steel inlet and outlet nozzles screwed and welded in. Blowing valve is new hard-seat type using special alloys to reduce wear. Made for 600 and 1,500 lb. pressure. —*Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.*



Blower

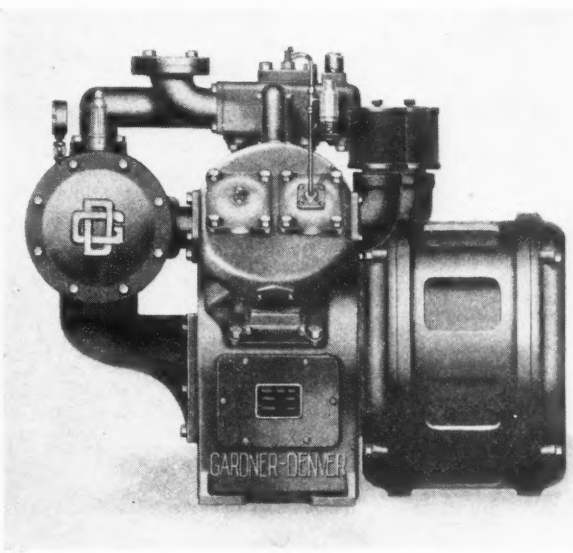
SINGLE piece of aluminum alloy. Combination propeller and multi-blade fan with vanes on tips of blades. Uniform suction with consequently high air volume and uniform discharge at low r.p.m. and low power consumption. High efficiency against static pressure.—*Leinweber Air-Conditioning Co., 8448 Crandon Ave., Chicago.*



BLOWERS, FANS, COMPRESSORS

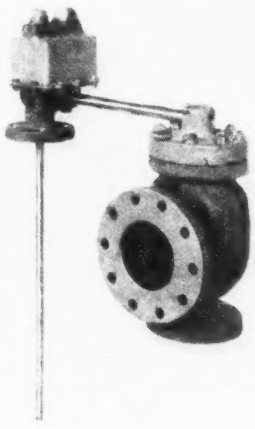
Portable Compressors

FOUR models, 2-stage for delivering 105, 160, 210 and 315 cu.ft., of air per min. Direct-connected to heavy-duty 6-cyl. gasoline engines. Feather valves, ring-type cooling fins, spray and forced-feed lubrication, oil filter and V-belt-driven cooling fan. 830-r.p.m. and 100 lb. gage air pressure. Variety of mountings.—*Worthington Pump & Machinery Co., Harrison, N. J.*



Horizontal Single-Stage Compressors

TYPE T has roller bearings, inclosed frame, bored and ground crosshead guides, solid crossheads, fork-end wedge-adjustable connecting rod, double counterweighted crankshaft. Either belt or direct-connected drive. "Simplate" valve. Cylinder sizes 6x7 to 20x13 in., speeds 400 down to 275 r.p.m., piston displacements 89 to 1,293 c.f.m.—*Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.*

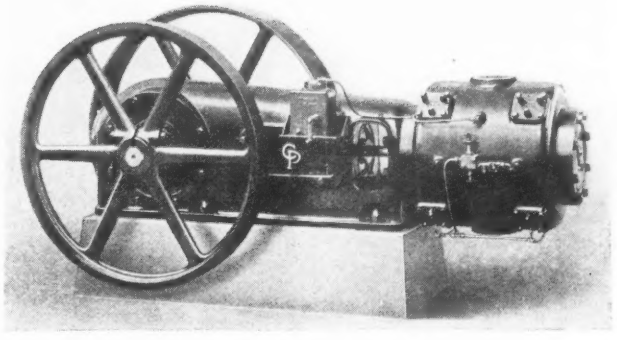


Safety Valves

TEMPERATURE - OPERATED valve opens instantly at definite temperature and closes when temperature reduces 25 deg. Pilot valve actuated by perpendicular bi-metallic thermostat connects to upper chamber of main relief valve, both connect to superheater. Thermostat expansion opens pilot valve to atmosphere, unbalancing pressure in chamber, and main valve opens.—*Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.*

3-Cyl. Air Compressors

SIZES from 113 to 194 cu.ft. per min. displacement. "WRR" have two small low-pressure cylinders instead of one large, resulting in lower air temperature and saving in power. Cylinder walls water-cooled, 2-stage construction for high efficiency. Force-feed lubrication. Pistons and cylinder walls lubricated by spray. May be run in either direction. Main bearings Timken heavy-duty tapered rollers. Pistons light-weight automatic type, with three compression and one oil ring on each.—*Gardner-Denver Co., Quincy, Ill.*

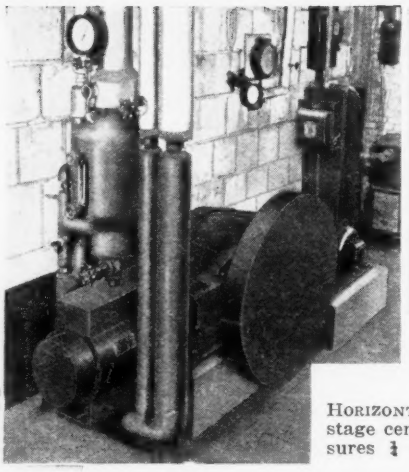


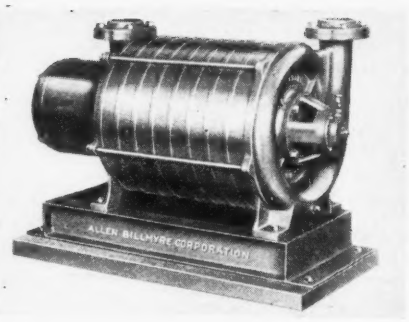
Blowers

ROTARY-positive blowers have all pipe connections below floor level. Built for top discharge. Built-in manual volume controls. — *Roots - Connersville Blowers Corp., Connersville, Ind.*

Compressors

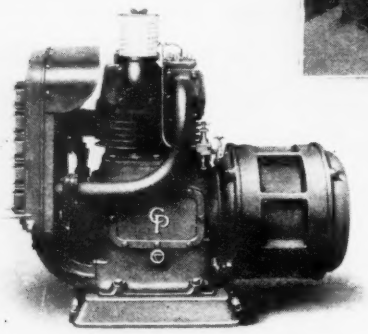
2-STAGE air-cooled motor- or belt-driven. "Simplate" valves; constant speed control, force-feed lubrication, and full-floating piston pins. Twelve models.— *Chicago Pneumatic Tool Co., 6 E. 44th St., New York, N. Y.*





Centrifugal Blower

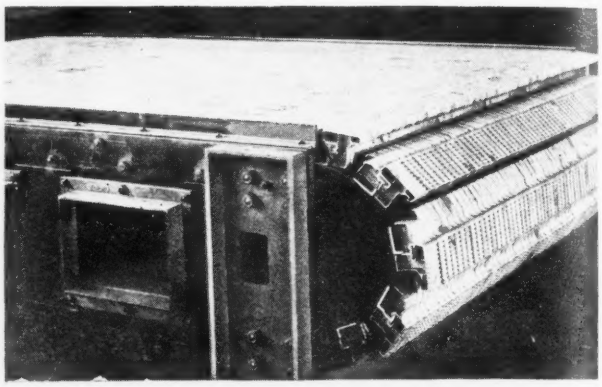
HORIZONTAL, single- or multi-stage centrifugal type. Air pressures ¼ to 5 lb. per sq.in., or vacua from 1 to 8 in. Hg. Free-air volumes from 50 to 10,000 c.f.m. Inlet head has streamline diffuser vanes, outlet vortex or scroll design for uniform discharge. Model MOH medium-volume unit shown, with built-in motor. Also Model FB with motor or belt drive and Model SM high-volume unit with sheet-steel case.—*Allen Billmyre Corp., South Norwalk, Conn.*

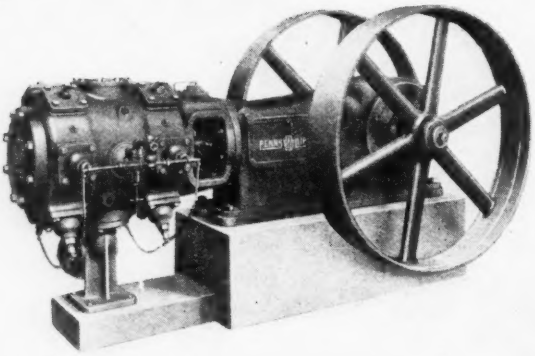


Steam Booster Compressors

TAKES steam from boiler system, raises pressure beyond capability of boiler itself. Drive either steam or motor with multi-V. Mechanical force-feed cylinder lubrication.— *Worthington Pump & Machinery Corp., Harrison, N. J.*

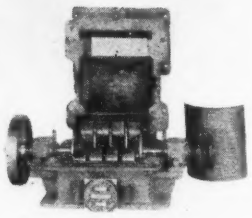
FUEL-BURNING EQUIPMENT





Stoker Grate Clips

HARRINGTON clips can be applied to existing stokers with replacement of bolts which hold grate angles to grate chain links. More uniform air distribution and minimize air leakage at side. Increase capacity 10 to 25%. Reduce siftings and maintenance.— *Riley Stoker Corp., Worcester, Mass.*



Air or Gas Compressor

CLASS 3-AT, single-stage, straight-line, Timken roller-bearing compressor is for heavy-duty service from 5 to 125 hp. 12 to 150 lb. Air-cushion valves. Drive by belt, or multiple-V, with motor overhead, in same plane, or direct-connected. Automatic stop and start control, or choking intake or by-pass unloaders for continuous operation, if desired.—*Pennsylvania Pump & Compressor Co., Easton, Pa.*

6-Cyl., 2-Stage, Water-Cooled Compressor

USES four small-diameter, low-pressure cylinders instead of two large. Water-cooled cylinder walls. Efficiencies comparable to those of large 2-stage horizontal units of same capacity. Motor mounted on shaft, V-belt to electric motor, diesel or gasoline engines, or direct-connected by flexible flywheel coupling to motor or engine.—*Gardner-Denver Co., Quincy, Ill.*

Slow-Opening Gas Valves

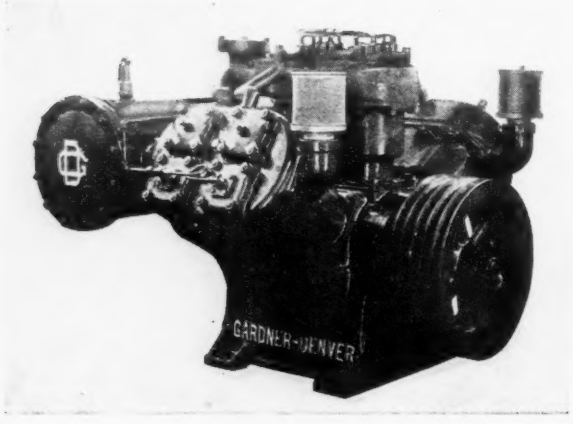
TIME of opening about 30 sec. and closing 3 sec. Motor operates valve through opening cycle; 50-lb. external spring in holder alongside of adapter rotates motor backwards to close valve. Valve sizes 1½, 2, 2½ and 3 in. are straight-through screwed type with bronze bodies, 3-, 4- and 6-in. sizes iron straight-through flanged type. All sizes relief type with small valve built in top of main valve. 3 lb. pressure rating up to 3-in. size, 1 lb. rating for 4- to 6-in. sizes. Provision made for operating valves manually during power failure. — *Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

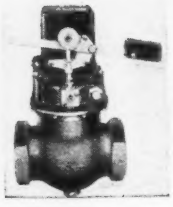
Laboratory Coal Crusher

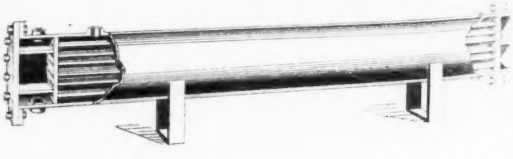
COMPACT and simple design with all parts of housing machined to insure dust-tight fit. Heavy construction. Two sizes, 9x9 and 15x9, first taking 1 to 5 hp.; second, 5 to 10. Can be furnished as shown in photo or mounted on stand or direct motor drive on cast-iron base.— *American Pulverizer Co., 1209 Macklind Ave., St. Louis, Mo.*

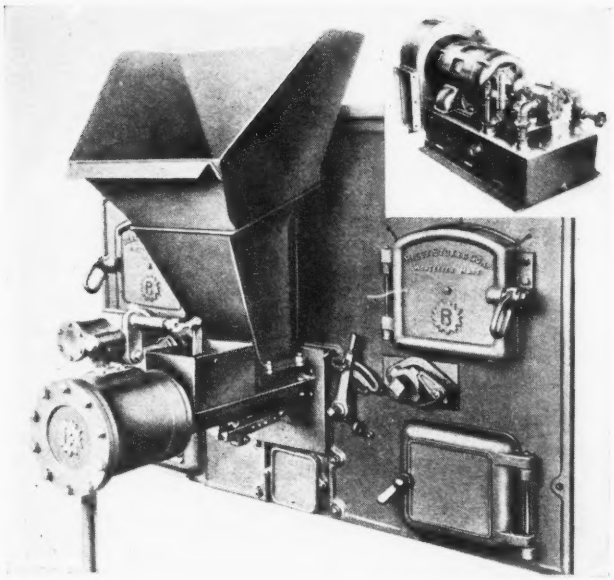
Fuel Oil Heaters

To reduce viscosity of fuel oil by heating before burning, these heaters use live steam at boiler pressure. For either vertical or horizontal operation. Straight-tube, multi-pass design. Any tube may be removed without disturbing others. — *Patterson-Kelley Co., E. Stroudsburg, Pa.*









Hydraulically Driven Side-Dump Stoker

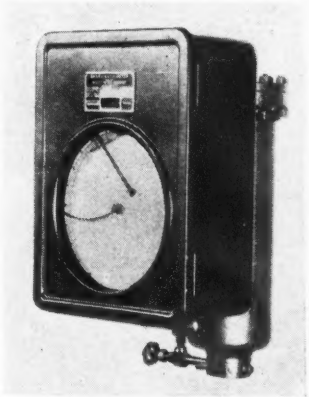
JONES stoker is rugged, electrically driven, plunger type. Moving parts are: piston direct-connected to coal plunger, operating valve and pusher rod. Gears, sprockets, etc., eliminated. Power unit at upper right in illustration.—*Riley Stoker Corp., Worcester, Mass.*

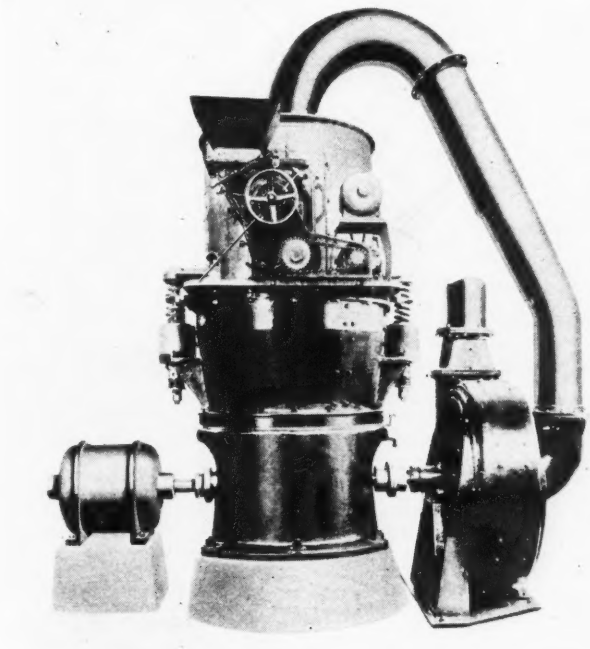
Bowl-Mill Pulverizer

COAL ground between reduction rolls and grinding ring works up walls of revolving bowl, or grinding chamber, due to centrifugal force, and fines and intermediate sizes are picked up by air current from annular spaces around bowl and carried into separator above for further classification. Pressure spring allows ungrindable material to pass rolls without injury. Equipped with air separator and automatic feeder. Adapted to both direct-firing and storage systems. —*Combustion Engineering Co., Inc., 200 Madison Ave., N.Y.C.*

Fuel Flow-Air Flow Meter

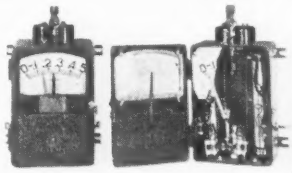
ENABLES operators to maintain definite relation between air and fuel supplied to furnace, to insure highest combustion economy. Two recording pens, one showing rate of air flow or gas flow, second recording flow of air for combustion. Operator simply keeps records of two pens together. Unit also records and indicates rate of flow of fluid, and total flow may be shown on 6-unit integrator. Auxiliary recorders of temperature or pressure to record on same chart. Each record is different color.—*Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio.*



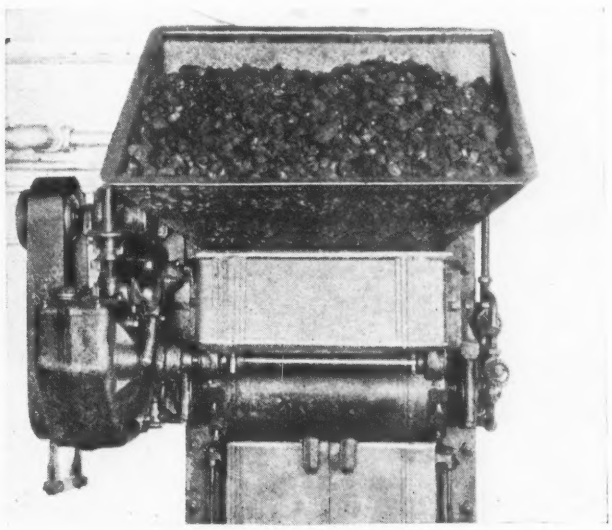


Draft Gages

"DRAFTROL" for indicating and controlling draft pressure or flow of gas or air, combines indicating draft gage of pointer

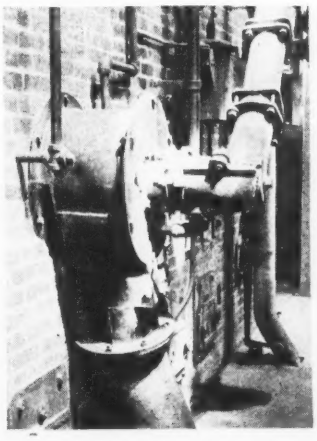


type with draft controller. Unit compact and dependable. Simple mechanism. Standard ranges for draft in, in. w.g., are: 0.3 0.5, 1, 2, and 5. One balanced range also; —0.1 to 0 to —0.4 in. Special ranges with hand-drawn scale. Slack leather diaphragm unit in ranges from 1/10 in. to 100 in. water. Higher pressure ranges employ metallic bellows or Bourdon tubes.—*Hays Corp., Box 299, Michigan City, Ind.*



Stoker

BURNS all types and grades of coal. Over-running rotor of solid cast-iron segments. Coal fed to rotor by large, slow-speed, reciprocating feeder shoe. Gates which determine height of fuel bed are pivoted to allow passage of tramp iron, etc. Entire frame water-cooled. Feed plate of ¼-in. steel slides in guides in stoker frame.—*Wm. Bros Boiler & Mfg. Co., Minneapolis, Minn.*

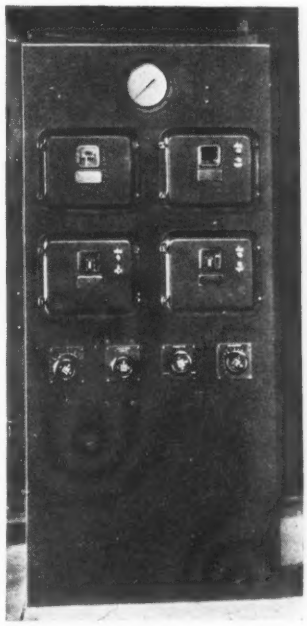


Cinder Burner

"STEAMATIC" consists of self-feeding intakes with fully-inclosed valves for connection to soot and cinder hoppers, transport line, and vacuum producer at end of line discharging into furnace and burner for supplying and mixing of auxiliary air. Exhauster operated either by steam or compressed air. Steam consumption is about 200 to 300 lb. per ton of material conveyed. —*United Conveyor Corp., Old Colony Bldg., Chicago, Ill.*

Combustion Control

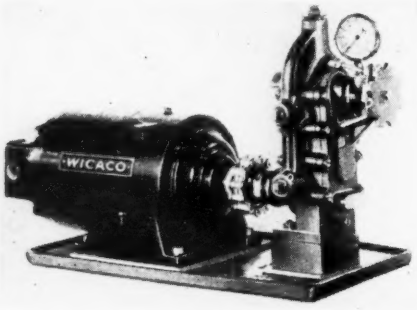
"METERMAX" control is ready for installation. Maintains air-loading pressure in definite rela-



tion to steam demand and balances against this pressure-metered supplies of fuel and air to each boiler individually. Four controllers ready mounted and connected on a panel. Master controller connects to all boilers and balances steam pressure against air-loading pressure. Only connection between panel and drive unit is a conduit carrying control wires. Below controllers on panel are fuel-air rheostat, load adjustment valve, transfer valve and selector switch. Suitable for small boilers as well as large.—*Leeds & Northrup Co., Philadelphia, Pa.*

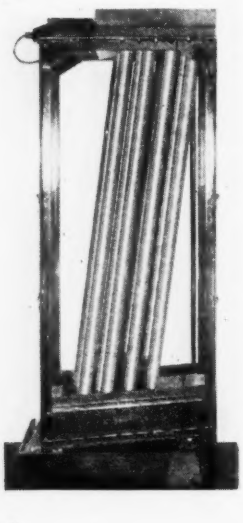
Fuel-Oil Metering Pump

TYPE C-F can be used in handling "Bunker C" or No. 6 fuel oil. Able to raise heavy oil at low temperatures from underground tanks, with tank temperatures down to 35 deg. Slow-speed operation (200 r.p.m.) through reduction-gear, or similar drive. Adjustable to provide constant flow to burner, regardless of oil temperature, pressure or viscosity. Gears will pass any normal sediment found in No. 6 oil. Dual or two-stage units, with or without electric drive.—*Wicaco Machine Corp., 4801 Stenton Ave., Philadelphia.*



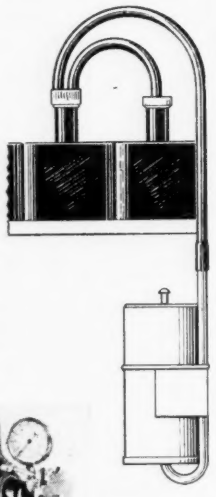
Dust Catcher

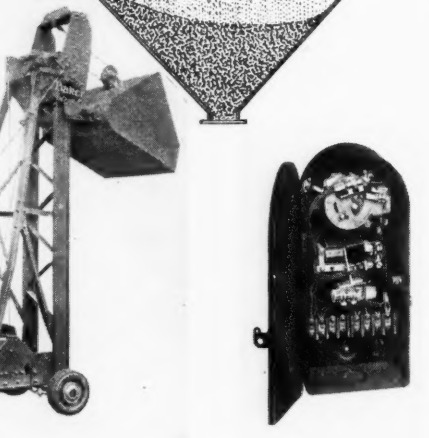
"DEDUSTER" is of water-film type, consisting essentially of nests of elements with tubes having outer surfaces corrugated to form spiral thread. All parts which flue gas and water contact are corrosion-resisting. Water requirements ½ lb. per min. per element. Maximum drop in flue-gas temperature 150 deg. F., or 0.6 in. water pressure drop at normal velocity. — *Diamond Power Specialty Corp., Detroit, Mich.*



Air Bell For Orsat

DESIGNED to replace rubber air bag on Orsat gas analyzers, it consists of a floating bell in a cup filled with water up to head. Weight of bell provides necessary air pressure, which is constant for full range of bell movement, approximately ¾-in. water head for 50-ml. (cc), and 1 in. for the 100-ml. analyzers. Bell assembly and fittings are brass, nickel plated. — *Ellison Draft Gage Co., 214 West Kinzie St., Chicago, Ill.*




SLOTS THROUGH WHICH DUST PASSES INTO DUST CHAMBER
SIDE OF EXISTING DUCT
DUST CHAMBERS, OPEN AT BOTTOM TO HOPPER AND PARTLY OPEN AT TOP TO UPPER PASSAGE
BY-PASS DAMPER
UPPER PASSAGE OR BY-PASS

Scoop Truck

TYPE HFG (2,500-lb. capacity) will handle cinder or load coal into stoker hoppers. Carriage travel limit protected by switches. Parts interchangeable with those of other trucks. Either storage battery or gasoline-electric power.—*Baker Industrial Truck Division, Baker-Rauling Co., Cleveland, Ohio.*

Stoker Control System

"STOKATHERM" (illustrated) operates in conjunction with "Sensatherm" boiler limit control, and "Pyratherm." Firing periods are regulated to maintain minimum fire when thermostat is in "off" position. System compensates for burning rates. *Mercoid Corp., 4201 Belmont Ave., Chicago, Ill.*

Rehandling Grab Bucket

(Cut at left)

TYPE RH bucket has special shells of intermediate shape between flat and round, giving advantages of flat shell for digging and filling, and round shell for quick discharge. Low height, extra width, and low center of gravity give less headroom in vessel or car and greater stability on a pile. Rope reeving without reverse bends and 3-part purchase.—*Mead-Morrison Division, Robins Conveying Belt Co., 15 Park Row, New York, N. Y.*

Analyzer Vision Panel

(Drawing at left)

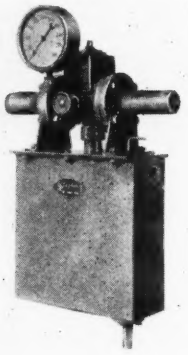
To improve visibility of solutions in absorption chambers of Orsat-type gas analyzers using fibrous material for surface absorption, this vision panel is made of opal glass and placed in front of chambers with space between panel and chamber wall for solution passage. White background, close to wall of chamber.—*Ellison Draft Gage Co., Inc., 214 West Kinzie St., Chicago, Ill.*

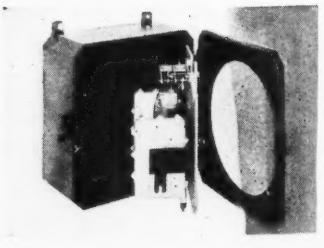
Venturi Dust Trap *(Cut at left)*

THERMIX has low resistance to flow, good collection efficient will go into an existing duct, and is low in cost. Consists of series of venturi-shaped passages through which gas or air passes horizontally. Gas or air is speeded up as it approaches throats, causing dust particles to be carried by their momentum to the converging walls of each passage, where they concentrate. *Prat-Daniel Corp., Port Chester, N. Y.*

Viscosity Indicator

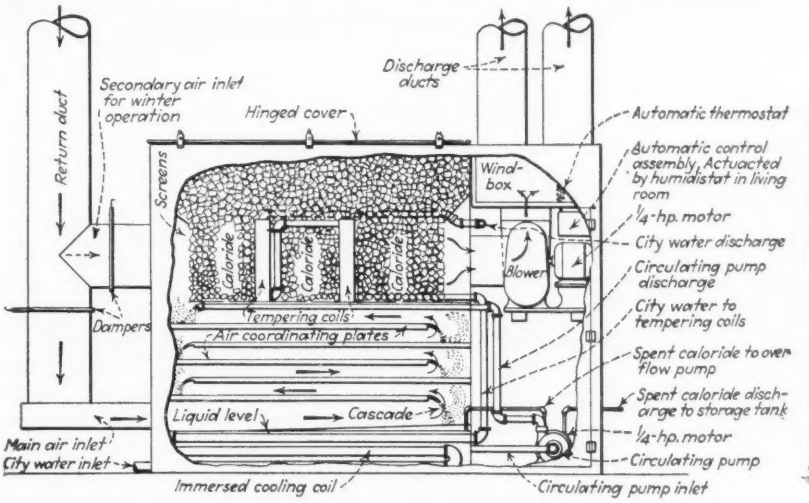
FLO-RATOR constantly indicates viscosity of a moving fluid. Inserted in the pipeline through which viscous liquids are being pumped. Gage dial calibrated in Saybolt seconds. Sample of liquid passed through Flow-rator may be returned to fuel tanks by gravity or admitted to a float-controlled receiver. — *Sterling Engine Co., Buffalo, N. Y.*





Draft Pressure and Differential Recorder

SERIES "OT" and Series "OH" draft pressure and differential recorders for ranges between 0.1 in. water and 100 in. water total scale. Illustrated is 2-pen recorder at bottom of lug-mounted case and back of flange case. Seth Thomas spring-driven or Telechron electric clock. Series OH are supersensitive recorders for ranges of differential pressure between 0 to 0.1 in. water and 0 to 0.4 in.—*Hays Corp., P. O. Box 299, Michigan City, Ind.*



Humidity Control System

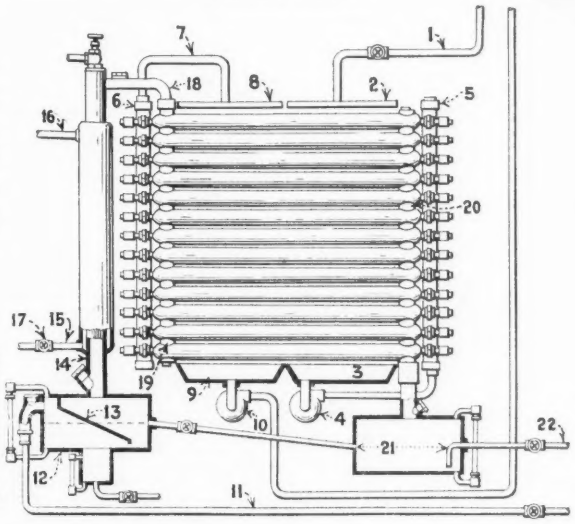
"CALORIDER" system has two distinct functions, control of effective temperature and air purity for comfort, or control of humidity and air purity for industrial applications, including drying and purification of gases. Automatic humidistat control. Only power required is two ¼-hp. motors.—*Research Corp., Colorider Div., Chrysler Bldg., New York.*

Cement Insulating Material

"PORETHERM" heat - insulating material in two weights, 19 and 32 lb. per cu.ft. can be precast or poured in field. Crushing strength to 150 or 200 lb. per sq.in. Material is permanent and fireproof, does not deteriorate or spoil when exposed to moisture, odorless, vermin-proof and fungi-proof.—*Porete Mfg. Co., North Arlington, N. J.*

Conditioning Cabinets

CENTRAL conditioning cabinet in capacities of 3 to 24 tons in combinations for simple cooling or complete air conditioning has welded steel plate base with drain connection which acts as condensate drip pan. Removable casings of galvanized iron. Graphite and bronze sleeve bearings floated on rubber insulators.—*Buffalo Forge Co., Buffalo, N. Y.*



Automatic Double-Pipe Ammonia Condenser

IN THIS condenser individual tubes may be shut off from system and cleaned without interference with operation. Water supply in circulating system flows over discharge ends of condenser tubes, then through inside tubes, counter-flow to vapor, finally over intake ends of condenser tubes to insure maximum heat transfer, provide means for converting superheat gas into saturated vapor, and wash out oil and oil vapors before condensing tubes are reached. Unit is welded with shielded ammonia joint tested on 375 lb. hydrostatic pressure. —*J. Henry Beckman Co., 932 57th St., Oakland, Calif.*

Steam-Return System

WATER in circulating tank flows into line pump, discharges through vacuum chamber into pipeline in rear of tank and back into tank. Return condensate enters through vacuum chamber, discharges into line in rear of tank, mixes with circulating water and goes back into tank. Excess is forced directly to boiler.—*Becker Pump Co., 463 Second St., Oakland, Calif.*

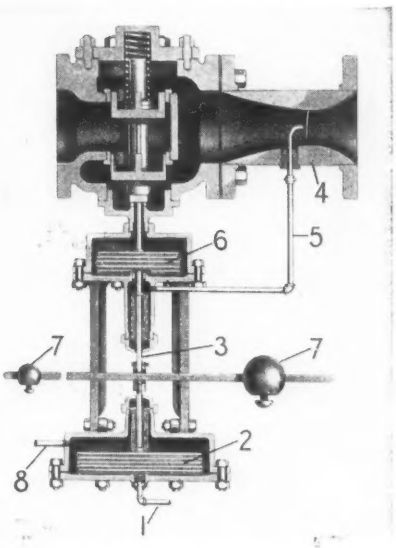
Unit Heaters

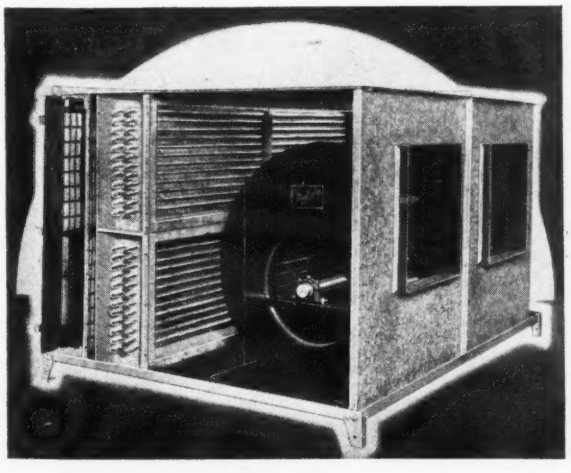
(Cut at left)

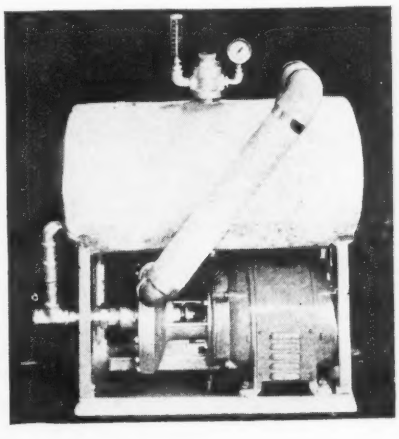
PROPELLER types for ceiling and floor mounting, and ceiling, wall and floor blower units known as "Torridor Series." "Multiflex" grille may be attached to outlet nozzles of heater or over ducts for direct heat in various directions. "Flexitrol" consists of manually controlled dampers just above heating elements.—*Trane Co., La Crosse, Wis.*

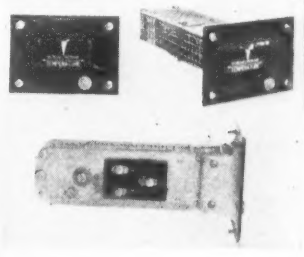
Control for Heating System

"SARCO GRADUATOR" system for automatic control of heating in large buildings can be applied to 2-pipe steam-heating systems of all types. One thermostat outside building and one inside regulate steam supply in accordance with building heat loss. Automatic graduator at each radiator inlet for uniform steam distribution. Outdoor thermostat, an air-cooled sealed tank, connects to main steam supply valve (illustrated).—*Sarco Co., Inc., 183 Madison Ave., New York, N. Y.*







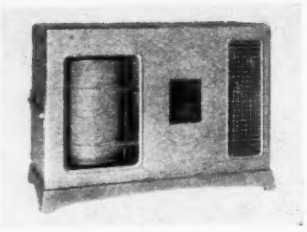


Insertion-Type Humidity, Temperature Controls

EITHER closely graduated in percent relative humidity from 11 to 100%, or in a variety of temperature ranges. Control humidity to within plus or minus 1% R.H., or temperatures to within plus or minus ½ deg. F.—*Julien P. Friez & Sons, Inc. Baltimore St. & Central Ave., Baltimore.*

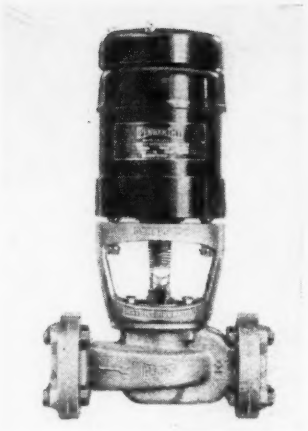
Condensing Units

Low suction-pressure units from 31 deg. to 43 deg. Standard range −13.5 to +20 deg. above 1-hp. and 1½-hp. models, and standard and high suction ranges in 2- and 3-hp. models. Air-cooled units have large shrouded condensers which direct air through condenser and over motor; also automatic reset and thermal overload starting switch. Units using air or water for a cooling medium are available in capacities of 3,390 (at a refrigerant temperature of −10 deg. F) to 32,650 (at a refrigerant temperature of +40 deg. F.) B.t.u. per hr. Charged with Freon.—*Westinghouse Electric & Mfg. Co., E. Pittsburgh, Pa.*



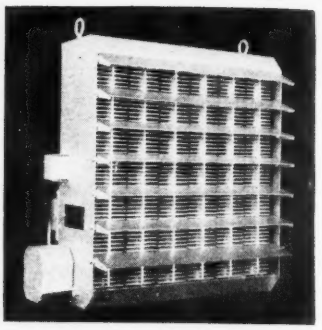
Hythergraph

Gives simultaneous record of relative humidity and dry-bulb temperature on common time lines.—*Julian P. Friez & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.*



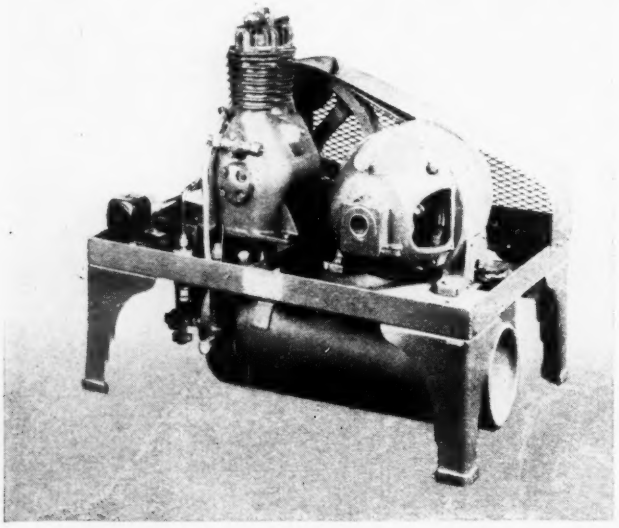
Water Circulation

Forces water from hot-water heating boiler throughout system whenever motor is started, thus avoiding delay in heat delivery. Also will circulate water to radiators below boiler-room or to remote radiation. Centrifugal pump bronze, driven by 110-volt condenser start-and-run single-phase motors. Sound insulated; motor flexible-coupled to the impeller. Three sizes, 1,250 to 6,000 g.p.h. against 1-ft. discharge head.—*Penberthy Injector Co., 12442 Holden Ave., Detroit, Mich.*



E'ectric Heater

Variety of sizes of "Electromode" heaters have helicoil sheath-wire type resistance heater element cast integral with aluminum fin-type grid. Maximum temperature 250 deg. Rectangular and round shapes. Portable, built-in-wall, and industrial-type units.—*Electric Air Heater Co., Division of American Foundry Equipment Co., Mishawaka, Ind.*



Unit Heaters

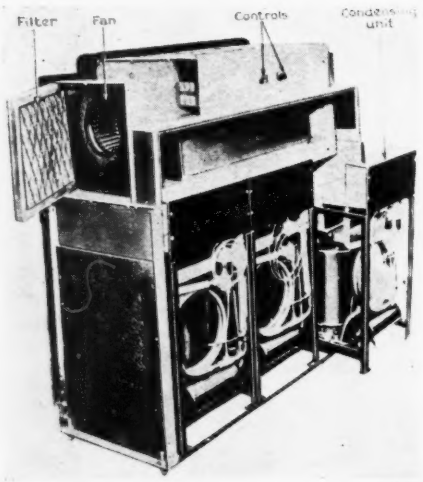
Four "Modine" models feature direct-from-steam-pipe-suspension. Expansion-bend allows individual expansion of each or separate tubes. — *Modine Mfg. Co., Racine, Wis.*

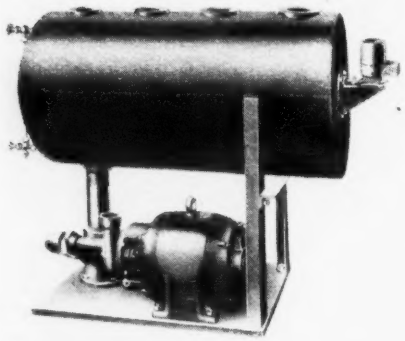
Condensate Return Unit

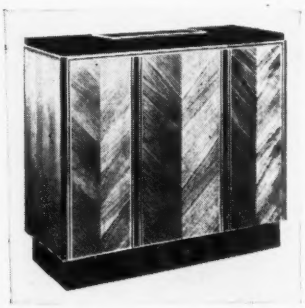
54 sizes and types of automatic "Monobloc" units with ratings from 2,000 to 40,000 sq.ft. of direct C.I. radiation or equivalent. Pump capacities 3 to 60 g.p.m.; storage-tank capacity 22 to 98 gal., and discharge pressures 10 to 40 lb. per sq.in.—*Worthington Pump & Machinery Corp., Harrison, N. J.*

Portable Air-Conditioner

Self-contained, walnut panels and satin chrome trim on cabinet. Telescopic intake duct connection in rear. Mounted on rubber-tired ball-bearing casters. No water supply or drain pipe. 2-cyl. 1¾x1¾-in. Freon compressor above ¾-hp. motor for compactness and rigidity, driven by V-belt. Cooling capacity of about ⅝ ton of refrigeration. 9-in. radial fan circulates 270 cu.ft. of room air per min. of which 25% may be outside air.—*York Ice Machinery Corp., York, Pa.*





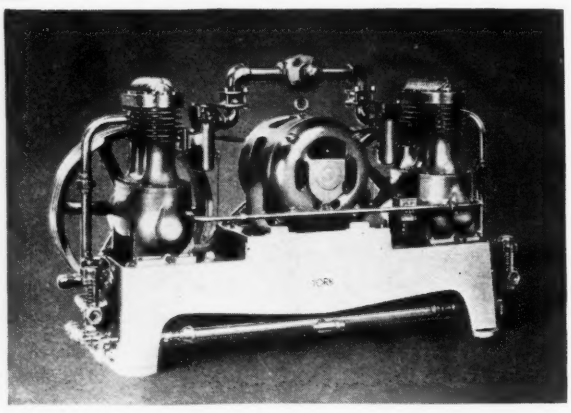


Small Air-Conditioning Unit

Self-contained Type FC-2 operates on 110-volt a.c., circulates 275 c.f.m. per min. Compressor, evaporator, air-cooled condenser, expansion valve, refrigerant (Freon) and oil are hermetically sealed at factory. Manually controlled interlock.—*Gen. Elec. Co., Bloomfield, N. J.*

Unit Heaters

Seven sizes have been added to line of Series 3 unit heaters to provide sizes and capacities up to 1,300 EDR.—*Fedders Mfg. Co., Buffalo, N. Y.*



Condenser Unit *(Cut at left)*

Freon "Balanseal" condensing units have been extended from 7½ to 25 hp., giving 18 machines in series. Also three new horizontal-type air conditioners in capacities up to 30 tons. New units are all on one base. 10-hp. model is single compressor, while others are duplex units with motor in center of base and belted to identical compressors in each end. 15-hp. unit is a duplex, with two 2-cyl. compressors; 20 and 25-hp. units have two 3-cyl. compressors. Illustrated is 20-hp. duplex unit.—*York Ice Machinery Corp., York, Pa.*

Condensate-Return Unit

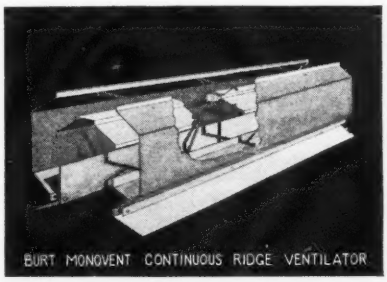
SIZES with 1,000 to 12,000 sq.ft. radiation. Automatic control switch on top, connected to copper ball float in tank. Tank and pump on steel base. Strainer in suction line. — *Decatur Pump Co., Decatur, Ill.*

Metal Heat Insulation

FERRO-THERM consists of parallel spaced metallic sheets with dull or non-bright surfaces. The sheets have low emission and high reflection values at the frequencies of radiant heat. Construction secures rigidity, eliminates vibration and prevents sound waves. — *American Flange & Mfg. Co., 26 Broadway, N. Y. C.*

Ventilator

SEVEN sizes from 3 to 24 in. in 10-ft. lengths. Inner deflecting baffle to prevent backdraft from upward flowing air current and direct internal circulation to secure wind suction effect. Can be used on ridge, slope flat deck or built-up curbs. Damper operates vertically.—*Burt Mfg. Co., Akron, Ohio.*



Thermo-Shield Psychrometer

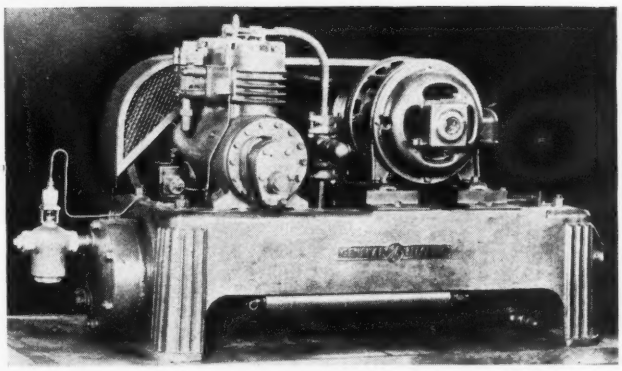
AIR sample drawn through top to eliminate error due to radiation. Thermometers graduated from −5 to +130 in ½-deg. increments. Fan operated by 110-volt a.c. motor.—*Julien P. Friez & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.*

Brine System Corrosion Control

SODIUM - CHROM - GLUCOSATE, an alkaline organic chromate, is said to provide efficient corrosion control in brine, condenser, and other water systems, where water is not used for human consumption, between a pH of 6 and 12. 150-, 300- and 500-lb. drums.—*D. W. Haering & Co., Inc., 3408 Monroe St., Chicago.*

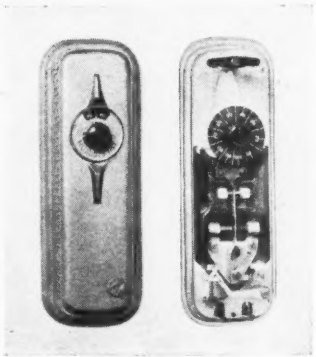
1-3 Ton Unit Cooler

FOR installation with a compressor (either air or water-cooled) using any common refrigerant, except carbon dioxide. Condenser of continuous copper coil type. Units also available for ammonia, using steel tubing. Suspended from ceiling. Three standard sizes.—*Modine Mfg. Co., Racine, Wis.*



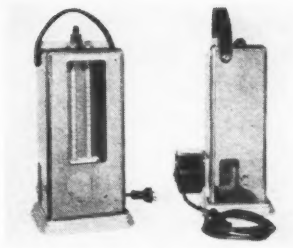
Condenser Unit

EIGHT units from 1½ to 20 hp., rated at 1.8 to 21.5 tons refrigerating capacity, have been added. Types CM-51S, CM-81W, and CM-81S have water-cooled, double-tube counterflow condensers. Types CM-81L, two Types CM-9L, and two Types CM-10L have shell-and-tube condenser-receivers. All types have external motors with multiple V-belt drive and compressors, liquid refrigerant filters, suction pressure controls, high-pressure safety lockouts, water regulating valves, also magnetic motor-starting switch and thermal overload protective device for motor. Full charge of lubricating oil and holding charge of Freon refrigerant in unit as shipped. All units obtainable with several different motor and motor-starter combinations, d.c. and a.c.—*General Electric Co., Schenectady, N. Y.*



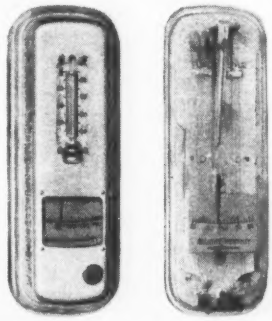
Humidity Controls

HUMIDSTATS control to plus or minus 1% relative humidity. Range of 10 to 100% R.H. — *Julien P. Friez & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.*



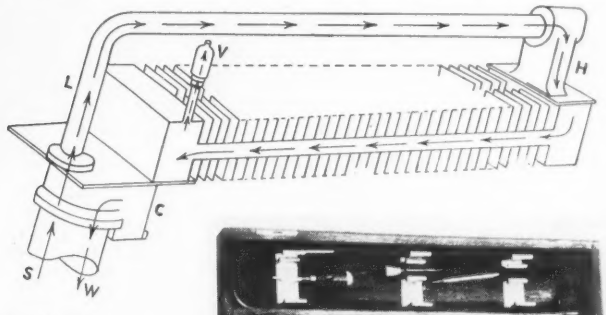
Psychrometer

MOTORED-OPERATED thermo-shield psychrometer for finding moisture content of air draws sample in through top and requires wetting of wet bulb for each reading, to avoid errors. Mechanism in case 7 in. square by 13 in. high, with glass window and integral rack for psychrometric tables.—*Julien P. Friez & Sons, Inc., Baltimore, Md.*



Humidity and Temperature Indicator

WALL- and insertion-type indicators incorporate multiple human hair elements to indicate from 10 to 100% relative humidity and standard thermometers to show temperature. "Satin silver" or "polished bronze" finish on casings. Humidity indications between —70 and 200 deg. F.—*Julien P. Friez & Sons, Inc., Baltimore, Md.*

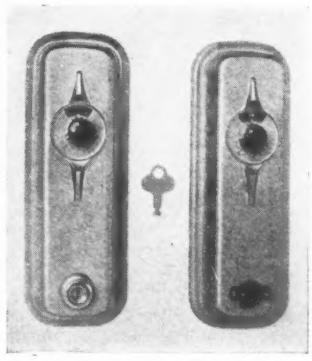


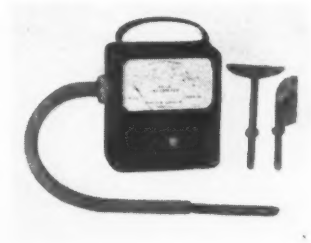
Single-Pipe Built-in Heater

"SIMPLEX CONVECTOFIN" operates on uniflow principle with series-parallel circulation, easy venting and compensation for pressure loss. Steam comes in at *S*, travels up to loop *L*, over to heater *H* and enters heater proper. Air is eliminated by valve *V*, condensate through compensator *C* and flows from heater at *W*.—*Commodore Heaters Corp., 11 West 42nd St., New York, N. Y.*

Thermostat

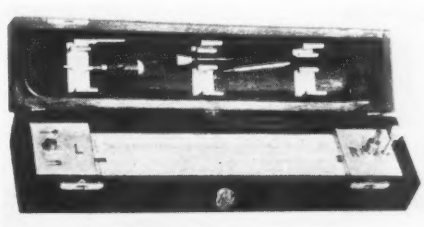
SENSITIVE to temperature changes as low as ½ deg. F., and with design that eliminates chatter. Includes summer-winter switches. — *Julien P. Friez & Sons, Inc., Baltimore, Md.*





Air-Velocity Meter

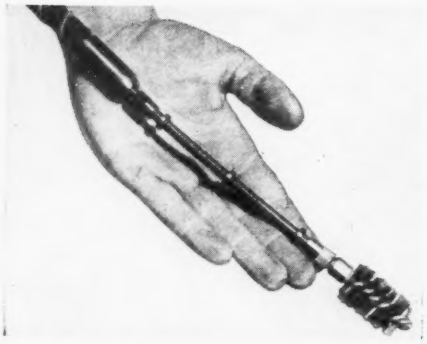
BOYLE Velometer reads speed and direction of air motion in feet per minute. Air passing through actuates a movement comprising vane, control springs, pointer and magnetic damping system. Pointer locking button. Two types, each with double-range scale; shutter type for taking quick commercial readings; tube type for accurate readings. Special scales and attachments. Standard scale ranges 0-300 and 0-3,000 f.p.m.—*Illinois Testing Laboratories, Inc., 420 N. LaSalle St., Chicago, Ill.*



Air Meter

FOR steady measurement of pressure or vacuum, and velocities of air inside ducts, at grilles, fans, etc. Covers velocities as low as 140 f.p.m. and up to 2,832 f.p.m., and pressure or vacuum from 0.00125 in. to 0.50 in. of water.—*Julian Friez & Sons, Inc., Baltimore St. & Central Ave., Baltimore, Md.*

HEAT-TRANSFER EQUIPMENT



Small-Tube Cleaner

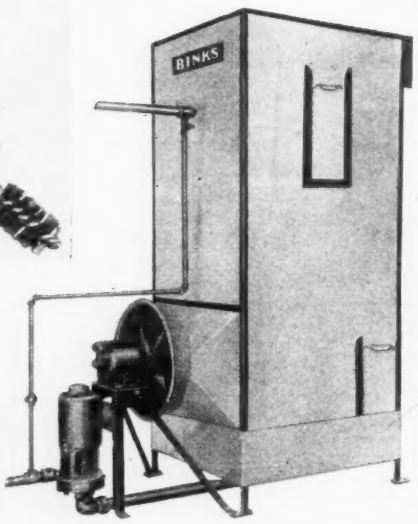
ROTO JUNIOR air-driven cleaner has only two moving parts. Several cleaners can be operated simultaneously. Will clean straight tubes as small as ⅝ in. o.d. and curved tubes with short-radius bends as small as ¾ in. o.d. Pressure 30 to 75 lb., air consumption 12 to 20 cu.ft. of free air per min.—*Roto Co., 142 Sussex Ave., Newark, N. J.*

Condenser Cleaner

"CONCO" water gun with 1-in. pipe inlet has large capacity to prevent pressure drop in shooting cleaners through larger (¾ and 1-in.) condenser tubes with low water pressures. Adaptable to any size tube by changing nozzle. Renewable parts.—*Condenser Cleaners Mfg. Co., 422 First Ave., Pittsburgh, Pa.*

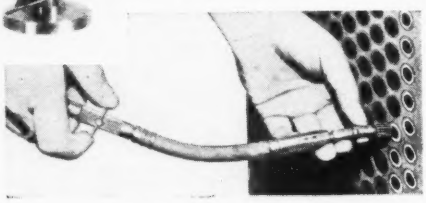
Condenser Tube Cleaner

"CONCO" cleaner, in four sizes from ⅝ to 1 in., has tempered stainless steel blades. All other parts brass.—*Condenser Cleaners Mfg. Co., 422 First Ave., Pittsburgh, Pa.*



Small-Tube Cleaner

"ROTO JR." has scraper head with replaceable blades, universal joint for attaching cleaning heads to motor and air valves directly behind motor for one-man operation. For straight tubes down to ⅝ in. O.D. and curved tubes with short-radius bends down to ¾ in. O.S.—*Roto Co., 142 Sussex Ave., Newark, N. J.*



Multi-Stage Cooling Tower

COEY tower operates efficiently over wide temperature range, thus increasing capacity for given size and weight. Also reduces spray loss by special spray eliminator at top. In drawing, light arrows represent air flow, heavy arrows water flow. Cypress baffles. Air entering at bottom passes through water three times before being exhausted. Driving motor in rainproof inclosure. Can be used for steam or gas refrigeration. Built to capacity or in cell groups.—*Research Corp., 405 Lexington Ave., New York, N. Y.*

Indoor Forced-Draft Cooling Tower

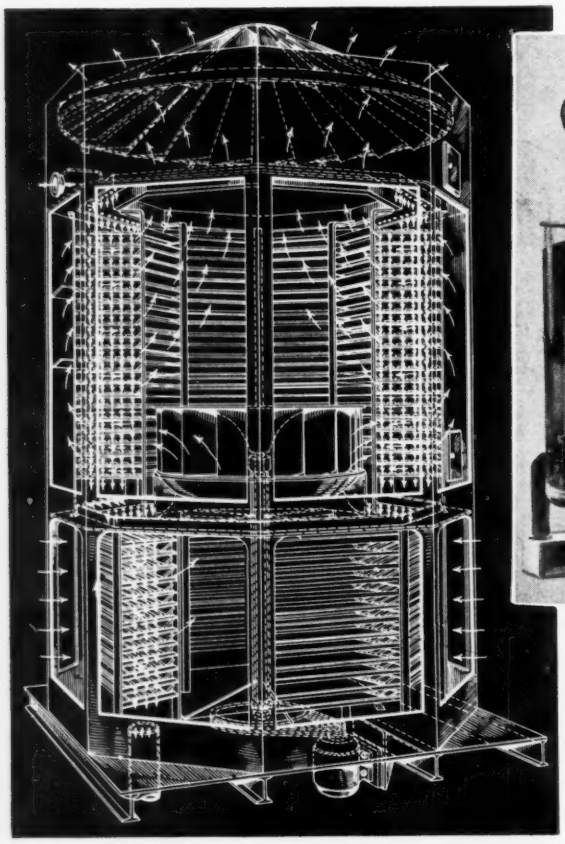
EIGHT sizes, ranging in capacity from 5 to 150 g.p.m. circulation. Simple design and construction. Two smallest sizes (5 and 10 g.p.m. capacity) furnished as complete, self-contained units; larger sizes made up in sections assembled on job. All sizes furnished with fan and fan motor, together with water-circulating pump where desired. Automatic operation where necessary. — *Binks Mfg. Co., 3114-40 Carroll Ave., Chicago, Ill.*

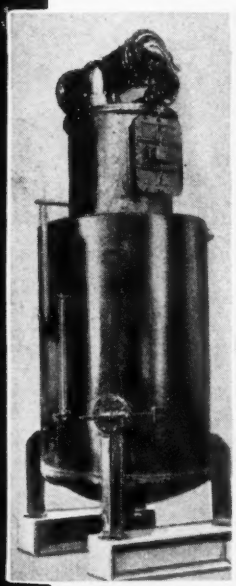
Deaerating Heater

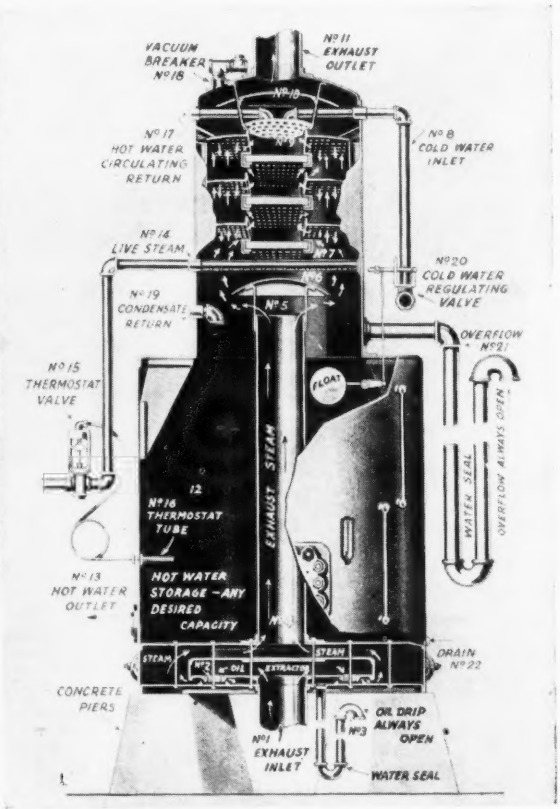
SPECIAL deaerating heater removes dissolved gases in feedwater, prevents corrosion in boilers, feed lines and steam lines, and heats feedwater to saturated steam temperature. Vent condenser on top and storage tank vertical. Heads are cast iron of non-storage type. Storage tanks may be vertical or horizontal. Design and construction meets all requirements of A.S.M.E. Code of Class 2 Unfired Welded Pressure Vessels, as well as requirements of American Bureau of Shipping and U. S. Shipping Board. — *Elliott Co., Jeannette, Pa.*

Hot-Water Heater

EXHAUST steam enters at 1, passes upward into oil extractor chamber 2, where oil is removed by rapid expansion of steam and drained through pipe 3 in combined hot water heater, oil separator and storage tank. Steam

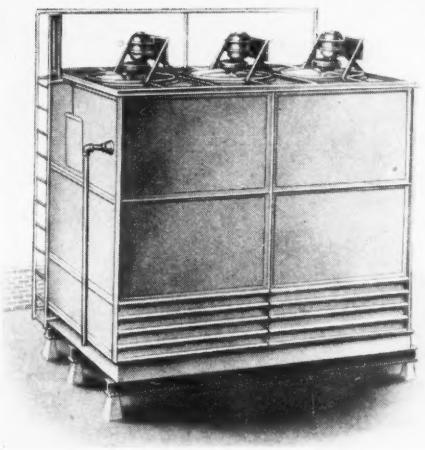






Left — Coey multi - stage cooling tower. Above—Elliott deaerating heater. Right —Marshall hot-water heater

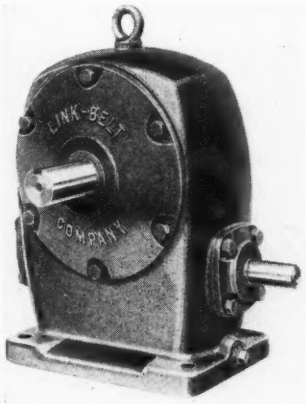
vaporizes upward through pipe 4 to baffle head 5 and filling chamber 6, then contacts series of perforated plates and removable trays 7, while cold water is entering at inlet 8, and discharging downward into distributing pipe 9. Surplus steam passes upward to baffle 10, thence to exhaust outlet. Hot water discharged into storage chamber 12, leaves through hot water outlet 13. Additional steam enters inlet 14 controlled by thermostatic valve 15, and tube 16. — *Marshall Heater Co., 716-726 Monument Ave., Dayton, Ohio.*



Cooling Towers

THESE towers have cooling capacities ranging from 5 to 200 g.p.m. Water distribution through low-pressure, clogproof "Rotojet" nozzles, which spray finely atomized mist of water downward through upward currents of air. Fans may be shut off during cool weather.—*Binks Mfg. Co., 3113 Carroll Ave., Chicago, Ill.*

MECHANICAL TRANSMISSIONS

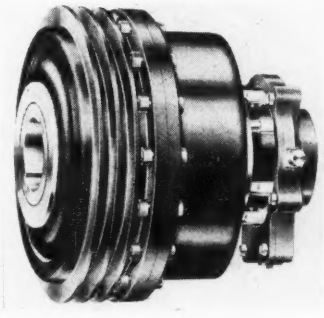


Worm-Gear Reducers

WIDE range of sizes, single- and double-reduction, horizontal and vertical types. Totally inclosed. Power transmitted through primary reduction helical gears to low-carbon, alloy-steel worm, thence to phosphor-bronze worm in single-worm units. Double-worm reductions also.—*Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.*

Friction Clutch

FAST'S friction clutch has coadjustment or self-alignment of rings composing friction element. This automatically distributes pressure uniformly over friction surface, increasing power transmission capacity by permitting greater unit pressure. Two types, C (coupling clutch) and L (line-shaft clutch), either with duplex or quadruplex friction element. Sizes from 2¼-in. to 24-in. bore, with maximum r.p.m. 4,500 to 450. Capacity 5.6 to 4,928 hp. per 100 r.p.m. (dynamic).—*Gustave Fast Engineering Corp., Annapolis, Md.*

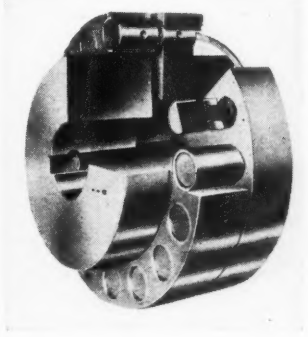


Flexible Couplings

"FABCO" Type R link-and-pin type with two flanges joined together by alternate pins connected to opposite ends of rubber-bushed metal links. Oval steel pin blocks set in rubber within circular link-end. Coupling halves aluminum alloy. Sizes from 1 in. to 12 in. bore to transmit 7.5 to 900 hp. per 100 r.p.m. at speeds from 2,400 for smallest to 450 r.p.m for smallest.—*F.A.B. Mfg. Co., 67th & Vallejo Sts., Oakland, Calif.*

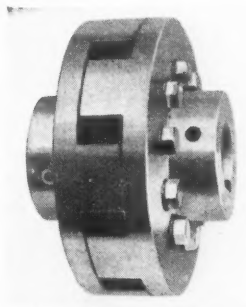
Flexible Coupling

FORGED, high-manganese, alloy-steel for smaller sizes, while larger sizes of "Francke" couplings are cast semi-steel. Bushings have highly polished bearing surfaces, with self-lubricating, wax-impregnated bronze bushing.—*John Waldron Corp., New Brunswick, N. J.*



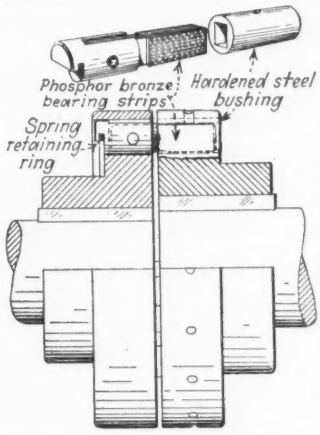
Flexible Coupling

L-R TYPE "P" couplings have individual free-floating load cushions hung between jaws on removable studs. Sizes for shafts from 3 to 10 in. dia. Three types of cushioning material. No lubrication required. In operation, half of cushions are idlers, except on reversing load, thus a set of new cushions is always available in coupling itself. Cushions can be interchanged easily. With suitable materials and designs, capacities can be increased to 250% of rating without change in over-all dimensions. — *Lovejoy Tool Works, 4976 West Lake St., Chicago, Ill.*



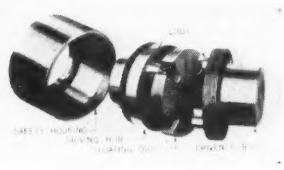
Couplings

RATINGS to 4,200 hp. for 100 r.p.m., and for shafts up to 13¼-in. diameter are included in 21 regular sizes of "Flexpin" couplings consisting of bundle of steel laminations copper coated to resist rust, held in slotted keeper by hardened steel cross-pins, welded type.—*Smith & Serrell, 1 Halsey St., Newark, N. J.*



Flexible Coupling

SELF-ALIGNING. Two round lugs set into each of two driving hubs. Lugs fit in recesses in periphery of bone fiber drive disk. Disk tends to float due to centrifugal action.—*Alloy Products Corp., 221 Madison St., Waukesha, Wis.*

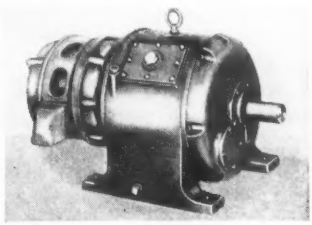


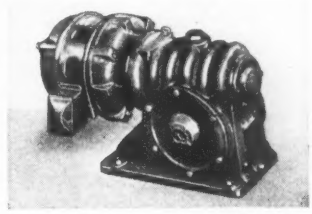
Flexible Coupling

FLEXIBLE chain coupling designed to provide for free operation without friction and excessive noise. Accomplished by special double width roller chains. Permanent shaft deflections up to 3 deg. can be handled without undue strains. Special heat-treated convex rollers.—*Baldwin - Duckworth Chain Corp., Springfield, Mass.*

Gear Motors

MOTORS and reducers either direct-connected or coupled in single, double and triple reductions for horizontal, vertical or right-angle drives. Motors on double- and triple-reduction units supported on gear case. All types of motors. "IXL" helical gear motors adopted to drives which require ¾ to 75 hp. and speeds down to 6 r.p.m. from 1,750-r.p.m. motors. Lower speeds by using lower-speed motors. "IXL" worm-gear motors in power capacities from ¾-hp. to 40-hp., with speeds down to 30 r.p.m. with 1,750-r.p.m. motors.—*Diehl Mfg. Co., Elizabethport, N. J.*



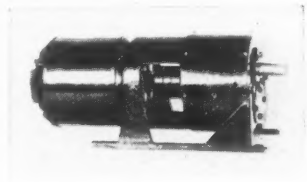


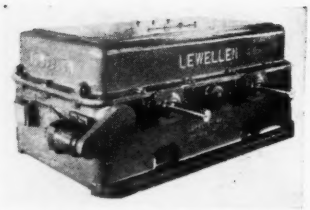
Brake Lining

THERMOID BX woven brake lining has asbestos tape base woven of heavy yarn containing brass wire and impregnated with highly resistant Bakelite resin. Has high coefficient of friction and ability to stand heat above 900 deg. F., in presence of oil, grease or water. — *Thermoid Rubber Co., Trenton, N. J.*

Helical-Gear Reduction Unit

LECTRIGEAR in sizes from ¼ to 2 hp. Standard footless motors used. Either with or without motors.—*Ajax Flexible Coupling Co., Westfield, N. Y.*





Remote-Controlled Variable-Speed Transmission

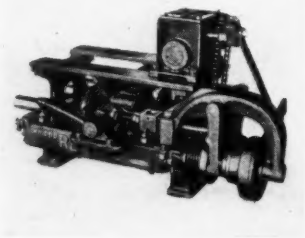
No. 175, Class D, completely inclosed variable-speed transmission has electrical remote control. Ball-bearing thrust bearings. All interior parts lubricated from one end from each shaft. Series of standard sizes. —*Lewellen Mfg. Co., Columbus, Ind.*

Non-Metallic Bearings

TEXTILE belting is saturated with synthetic rosin, then formed into bearing shape under heat and pressure. Either water or oil lubrication. 4 to 30 in. diameter in thickness $\frac{3}{8}$ in. up.—*Joseph T. Ryerson & Son, Inc., Chicago, Ill.*

Variable-Speed Ratchet Control

POWER input shaft driven from any source of power, drives to proper-ratio gear reducer through roller chain. Output shaft connected by adjustable arm to ratchet on extension of speed-changing screw. Adjustable arm varies timing of control.—*Reeves Pulley Co., Columbus, Ind.*

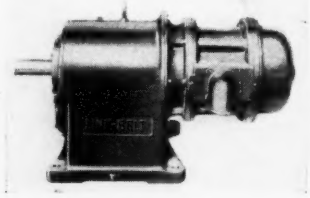


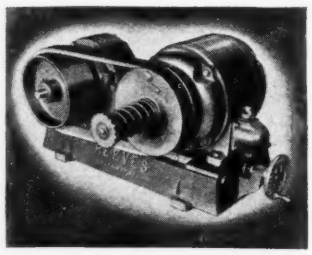
Bearing Housing Closures

COMPLETE closures finished and ready to use for about 150 sizes of ball and tapered roller bearings in a number of sizes and types to meet design requirements. Numerous shaft extension sizes can be utilized. Varying degrees of inside space permit mounting bearings with or without locknuts in fixed or floating positions and with proper abutting shoulder diameters.—*R-S Products Corp., Philadelphia.*

Motorized Reducers

MOTORIZED helical-gear reducers, N.E.M.A. standard round-frame motor secured to side of reducer housing by adapter casting, which supports motor shaft in oversize anti-friction bearings close to pinion. Motor with adapter and pinion may be removed as a unit. Oil seals. For floor, ceiling or wall mounting, double reduction from $\frac{1}{4}$ to 75 hp., ratios up to $38\frac{1}{2}$-1, and triple reduction up to 38 hp. in ratios up to 292-1.—*Link-Belt Co., 300 W. Pershing Road, Chicago, Ill.*



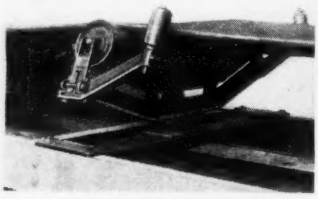


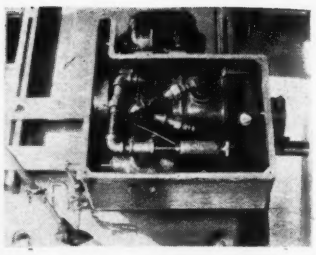
Mounting for Speed Reducer

STANDARD mounting permits direct drive from vari-speed motor pulley to reducer. Adjustable base, bolted stationary base. For all standard-size motor pulley units.—*Reeves Pulley Co., Columbus, Ind.*

Self-Aligning Belt Conveyor Idler

"POSITIVE" idler for troughed conveyor belts trains belt back automatically into a central position. Made up of standard belt-carrying rolls mounted in a supporting frame with arms extending parallel with and at sides of belt. Idler frame swivels promptly when crooked-running belt crowds sidewise enough to engage either idler.—*Link-Belt Co., 300 W. Pershing Rd., Chicago, Ill.*



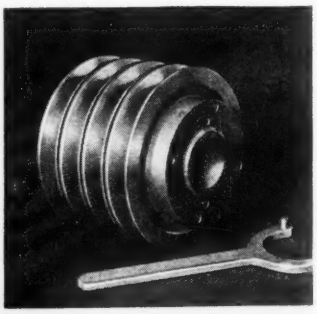


Speed Control

HYDRAULIC automatic (Hydraumatic) control for use with Reeves variable-speed transmission. Lever attached to element which indicates required speed, transmits motion to shifting levers which vary diameter of disk and V-belt. A.c. or d.c. motor operates geared pump through sprocket and roller chain under splash guard. Fluid motor actuates transmission to change speed.—*Reeves Pulley Co., Columbus, Ind.*

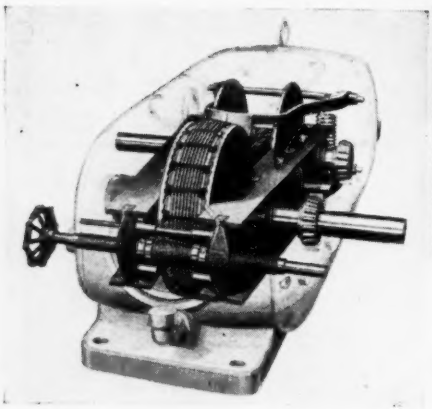
Sheaves

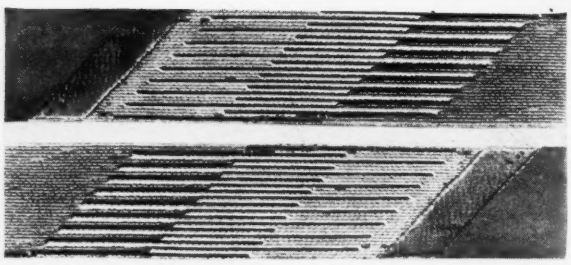
LINE of "Duro-Brace Texsteel" V-belt sheaves has been extended to include 15-hp. sizes. Grooved design for either A or B section belts. 25 diameters from 3 to 18 in., for two to six grooves. Interchangeable hubs with bores in 1/16-in. increments from $\frac{1}{4}$-in. up.—*Allis-Chalmers Mfg. Co., Milwaukee.*

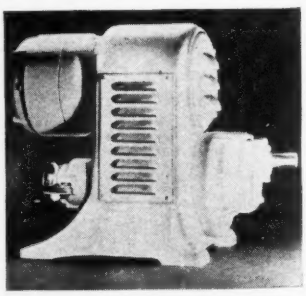


Texrope Sheave

PITCH diameter of "Vari-Pitch Texrope" sheave is adjustable to give speed variations up to 25%. Two multigroove types.—*Allis-Chalmers Mfg. Co., Milwaukee.*





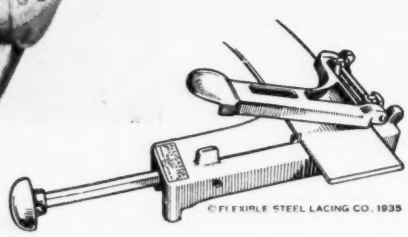


Variable-Speed Drive

TO SAVE lateral space and to have take-off shaft either high or low, "U.S. Varidrive" is offered in upright design.—*U. S. Electrical Mfg. Co., 200 E. Slauson Ave., Los Angeles, Calif.*

Speed Changer

P.I.V. gear variable-speed transmission now in five sizes to 15-hp. capacity, with integral motor if desired, with or without speed-reduction gearing, with horizontal or vertical box. Motor speed of 3,600 r.p.m. can be given speed range of 228 to 38 r.p.m.—*Link Belt Co., 2045 West Hunting Park Ave., Phila., Pa.*



Belt Cutter

PATENTED 8-in. flat belt cutter has knife mounted on plunger in slot, operated by direct arm push. Belt held by clamp which is also blade guard.—*Flexible Steel Lacing Co., 4607 Lexington St., Chicago, Ill.*

Vulcanized Belt Splice

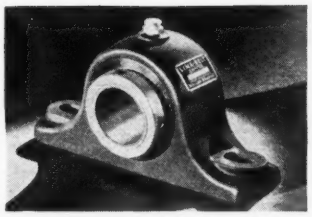
PATENTED splice permits rubber belt to be made endless in place. Belt ends joined together by dovetailing load-carrying core of cords at splice and by vulcanizing spliced portion.—*Goodyear Tire & Rubber Co., Akron, Ohio.*

Transmission Belt

CORDS embedded in rubber. Square-cut edges. Laminated and cut-edge construction permits use of single-ply duck on each side. Widths to 24 in., and plies from 5 up.—*U. S. Rubber Products, Inc., Mechanical Goods Division, 1790 Broadway, New York, N. Y.*

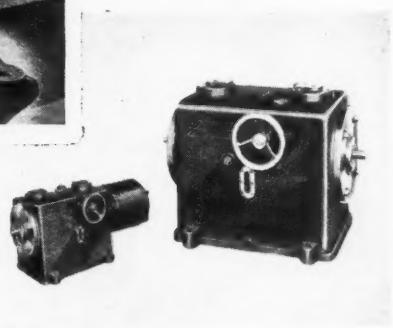
Compensated Belt

CONDOR compensated belt equalizes ply stresses when belt flexes around pulley.—*Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc., Passaic, N. J.*



Roller Bearing

SHAFER unit, "Series 400," uses self-aligning double-row, roller bearings with concave rollers between convex outer races and spherical inner race on sleeve, free to deflect with shaft out of line.—*Link-Belt Co., 300 West Pershing Road, Chicago, Ill.*



Variable-Speed Transmission

INFINITE variety of variable speeds accurately controlled, anywhere between 5 and 750 r.p.m. Proper speeds secured instantly by turning handwheel. Additional adjustment permits speeds up to 2,500 r.p.m. Hydraulic, mechanical, or electrical remote control if preferred. Units also with mechanism for instantaneous change of direction. Capacity up to 6 hp. continuous duty at 1,000 lb. per sq.in. and 7½-hp. intermittent service at 1,250 lb. per sq.in. Larger units later. Safety valve set at 1,500 lb. per sq.in. Drive by direct-connected 1,200-r.p.m. motor. Unit at left has flange-mounted motor direct-connected to pump shaft. — *Vickers Incorporated, 1400 Oakman Blvd., Detroit, Mich.*

Oil-Resistant Belt

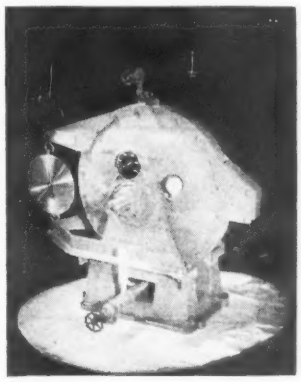
BELT 100% oil resistant. In both V-type and flat cable-cord type. —*L. H. Gilmer Co., Tacony, Philadelphia, Pa.*

Short-Length Bearing Bronze

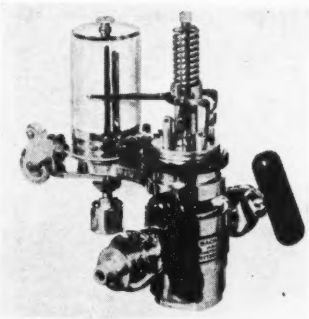
MAGNOLIA bearing bronze bushings in short lengths from 2 to 14 in. long up to 7-in. outside diameter. Semi-finished bronze bar stock may be ordered to exact size, with extra metal to allow cleaning up to sizes marked on bars.—*Magnolia Metal Co., 120 Bayway South, Elizabeth, N. J.*

Dynamometer

"TORQUE" dynamometer is of hydraulic absorption type. Claimed as smooth and accurate as electrical types, while more flexible and lower priced. Absorption medium is water, power being dissipated in heat, under control. Both stator and rotor on annular ball bearings. Water consumption nominal. — *Torque Products Co., 875 E. Lake Forest Ave., Milwaukee, Wis.*



METERS, RECORDERS AND TESTING INSTRUMENTS

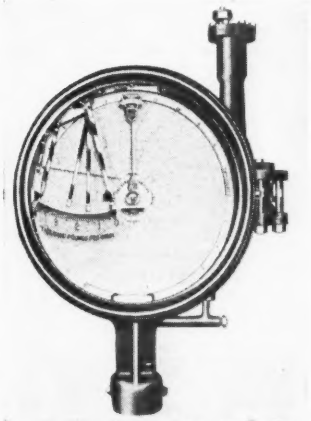


Pressure Recorder

PISTON-TYPE differential-pressure recorder for rapidly fluctuating pressures. Similar to engine indicator. Clockworks give chart speeds of from 7 to 72 in. per min., 10 to 100 ft. per min., 150 to 450 ft. per min. Within speed range, clock may be set for four intermediate speeds. Maximum standard range 2,000 lb. per sq.in., higher ranges by special construction.—*Bacharach Industrial Instrument Co., 7000 Bennett St., Piltsburgh, Pa.*

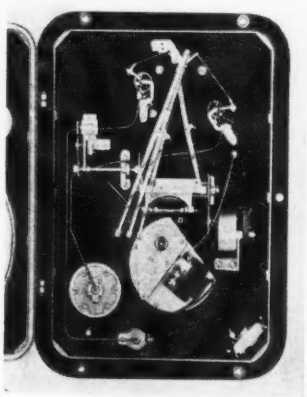
Mechanical Flowmeter

UTILIZING orifice and mercury manometer system of flow measurement. All parts counter-balanced. Meters for working pressures of 1,000 lb. tested at 2,000 lb. Special bodies tested at 5,000 lb. for working pressures up to 3,000 lb. Meters available for indicators, integrators, recorders or controllers. Recorders with pressure and temperature elements, if desired. Integrating flowmeters obtainable either with or without compensation for fluctuations in static line pressure. Suitable for use with either orifice plates or Venturi tubes. Can be arranged for electric flowmeter for remote reading. — *Bristol Co., Waterbury, Conn.*



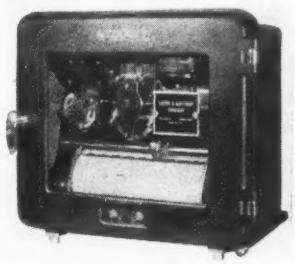
Universal Flowmeter

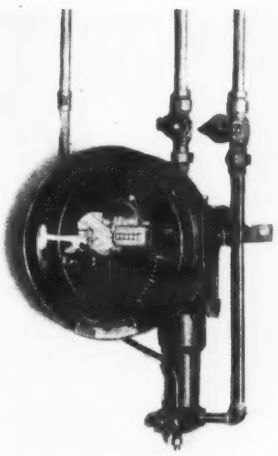
RECORDS temperatures and pressures on same chart with flow. All pens move about same center. Positive zero for ease in checking. Pressure compensator may be added. Special trumpet-shaped calibrated mercury chamber gives readings on upper portion of scale magnification of a 100-in. meter, and to those on lower portions magnification of 20-in. meter. Two types, one for pressures to 500-lb. per sq.in.; other for pressures to 1,500 lb. Transparent eccentric indicating scale and colored pointer on pen arm, if desired.—*Foxboro Co., Foxboro, Mass.*



Multi-Color Recorder

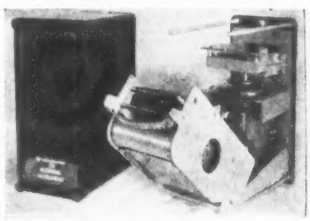
SPECIAL marking system for Micromax strip-chart recorders of two, three, four or six points, permits numerals in colors. Easy reading, errors avoided. Six colors available. — *Leeds & Northrup Co., 4910 Stenton Ave., Philadelphia, Pa.*





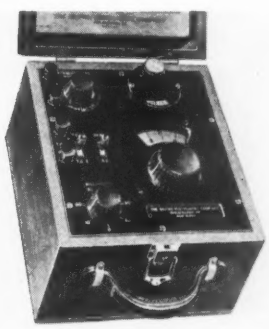
Distribution Meter

INDICATING-integrating meter with interchangeable flow mechanism shows total steam flow on 6-digit counter and rate by pointer and scale. May be furnished with contactors for maximum-demand recorder. Orifice type, not installed in pipeline.—*Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.*



Position Transmitter and Recorder

DUPLICATE position telemetering system for remote indicating and recording position of mechanisms. Type "GH" in rectangular case for panel mounting.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*



Portable Potentiometer

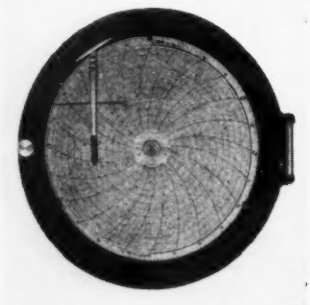
ENABLES users to check potentiometers, millivoltmeters and thermocouples. Combination of a step-switch and slide wire makes it possible to read indicating scale to 0.01 millivolts over total range of 71 millivolts. Indicating scale is 17 in. long, making smallest scale division over 1/16 in. in width. Fully enclosed, suspension type galvanometer has a very short period so readings can be taken rapidly. Can be used as a measured source of E.M.F. in checking recording potentiometers of self-balancing type.—*Brown Instrument Co., Philadelphia, Pa.*

Turbine Flowmeters

INDICATE and record water flow in terms of cu.ft. per sec. Will continuously integrate in millions of cubic feet.—*Bailey Meter Co., 1050 Ivanhoe Road, Cleveland, Ohio.*

Potentiometer Pyrometer

WIDE-STRIP pyrometer in single-record, multiple-record and recorder-controller types operates on potentiometer principle. Uses 12¼-in. chart equipped with 1¼ in. indicating scale. Dust-proof. —*Bristol Co., Waterbury, Conn.*

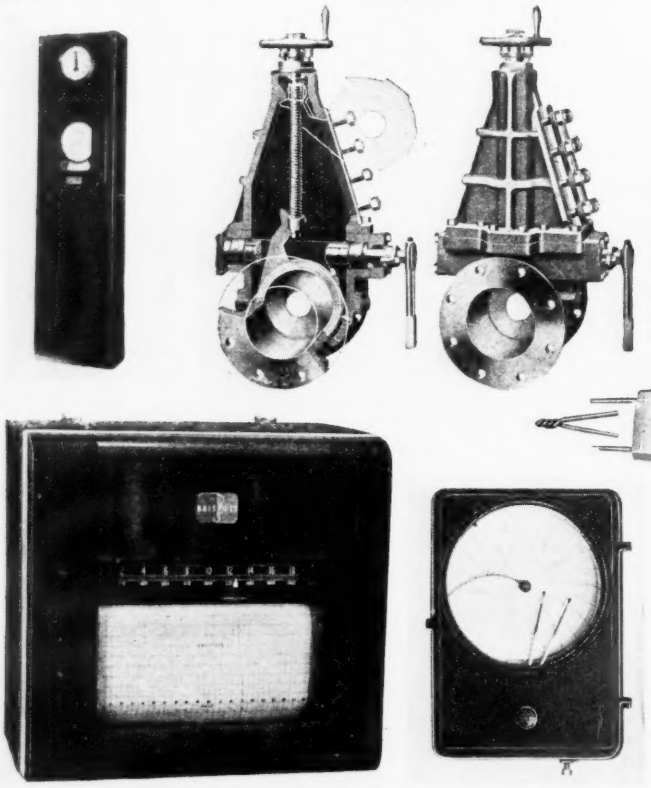


Recording Meter

MJL No. 37 actuated by differential pressure acting on flexible metallic bellows and balanced by calibrated coil spring which compresses in direct relation to differential pressure. Will record rate of flow directly.—*Morey & Jones Ltd., 922 So. Hemlock St., Los Angeles, Calif.*

Orifice Fitting

FOR handling gases and liquids. Device raises or lowers orifice-plate carrier and forces carrier into position in lower seats. For inspecting or changing, carrier is lifted completely out of upper chamber. Valve seats covered in both open and closed positions. Full-floating plug valve lubricated with equalized pressure. Indicator shows when orifice plate is in position.—*Robinson Orifice Fitting Co., 1435 Santa Fe Ave., Los Angeles, Calif.*

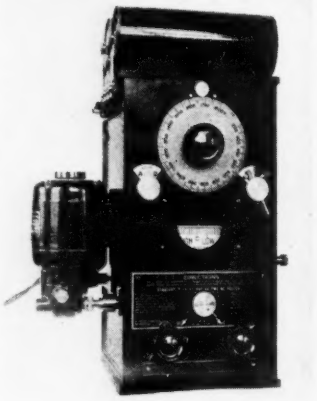


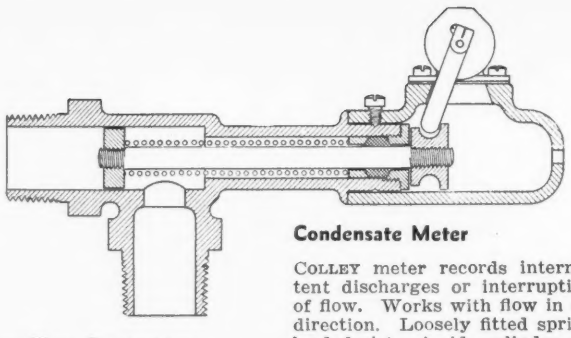
Meter Case

TYPE W case is cast aluminum alloy. Sponge-rubber gaskets make door moisture and dust-proof. Chart dial sized so that pressure spring stuffing box and other working parts are visible when door is open. In flow-control instruments door has two additional round windows. —*American Meter Co., 60 East 42nd St., New York.*

Motor for Pyrometers

TYPE H, for single installations of potentiometer - pyrometers, comprises a ball-bearing inclosed motor and double worm-and-gear speed-reducing system packed in lubricant. Also able to operate one additional controller through coupling.—*Foxboro Co., Foxboro, Mass.*





Lance-Type Pyrometers

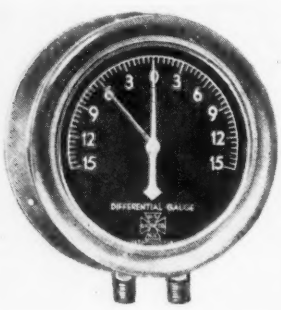
LOW-PRICED. Three temperature ranges, 800, 600 and 2,500 deg. F. Protecting case and handle single aluminum casting. Called "Hold-Heet." — *Russell Electric Co., 363 West Huron St., Chicago, Ill.*

Total Time Meter

TOTALIZES running or idle time on any a.c.-powered unit. Registers 9,999 hours before repeating. Meter may be at distance, connected by single pair of wires. Also with special register providing one revolution per hour of sweep hand.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Difference-Indicating Pressure Gage

CONTAINS two sensitive actuating elements (Bourdon tube or bellows) and linkage to indicate with one pointer difference between two line pressures acting on gage mechanism simultaneously. Dial sizes 3½ in. in diameter and up. Will show which line pressure is higher or lower. —*United States Gauge Co., 44 Beaver St., New York, N. Y.*

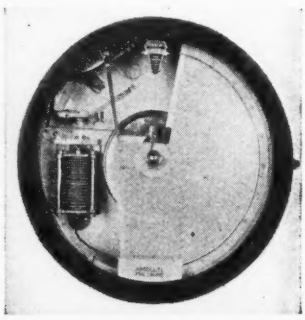


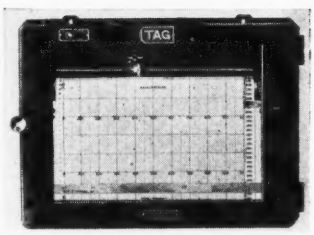
Condensate Meter

COLLEY meter records intermittent discharges or interruptions of flow. Works with flow in one direction. Loosely fitted spring-loaded piston inside cylinder acting against direction of flow. Counter attached to piston rod records number of times piston has been pressed forward. When flow starts piston is forced forward to uncover exhaust port and operate counter. When flow stops, spring forces piston back. — *Ammann - MacGregor, Inc., 2217 Olive St., St. Louis, Mo.*

Pressure Gage

Two hydrons, measuring direct and barometric pressures, so connected that pressures oppose each other. Compensating hydron, sealed under vacuum, counterbalances barometric effect on main pressure hydron. Contains no liquid.—*Foxboro Co., Foxboro, Mass.*





Potentiometer Pyrometers

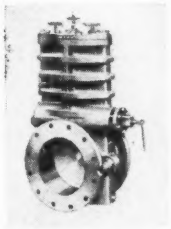
HIGH-SPEED photo-electric action. Recording done by means of light reflected by galvanometer upon a photo-cell. Accurate within 0.1%. Models for on-and-off 2- and 3-position controls, in single or double range for thermocouples and resistance thermometers. Also indicating potentiometer.—*C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.*

Low-Pressure Flowmeter

FOR measuring low-pressure liquids and gases which will not attack steel packing, this "Rotameter" has tapered-glass metering tube set into two short fittings mounted in steel case. 1- to 4-in. sizes, screw or flange connections.—*Schutte & Koerting Co., 12th and Thompson Sts., Philadelphia, Pa.*

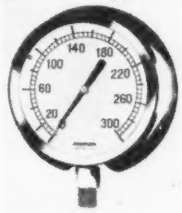
Orifice Fitting

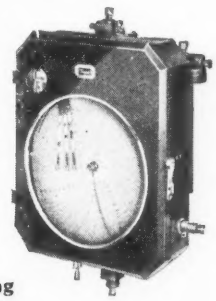
"COMMERCIAL" orifice fitting for meter set-up avoids by-passes, thus saving space. Threaded elevator lift permits lowering or lifting of orifice plates, regardless of line pressure, without shutting down line and with safety. Orifice plates accurately centered. Distributed by—*Foxboro Co., Foxboro, Mass.*



Steel Tube Gage

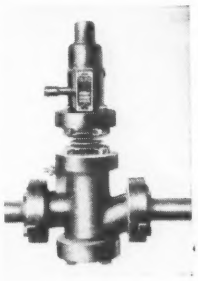
INDUSTRIAL 51-14 gage has welded-steel construction and nitrided-steel movement. 6, 8½, 10 and 12-in. sizes. Accuracy of ½% at working point, 1½% at other points above first 5% of scale. Accuracy of ¼% available.—*Ashton Valve Co., 161 South First St., Cambridge, Boston, Mass.*





Integrating Flowmeter

STANDARD flow recorder with added mechanism to give totalized indication of steam passing through orifice. With or without pressure compensating feature which corrects totalized flow for error due to compressibility of steam under varying pressures. Recording mechanism equipped with one, two or three pens for differential pressure, static pressure and temperature. —*Taylor Instrument Co., Rochester, N. Y.*

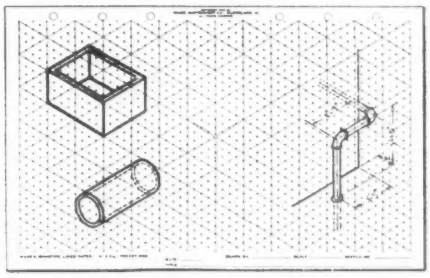


Area Flowmeter

AREA-TYPE meter avoids complex arrangement of piping and seals between meter body and pressure taps. Meter body is piston-and-sleeve type. Position of piston is definitely measured by an inductance bridge system. Calibrated to give equal increments in deflection or equal increments in flow, hence scales and charts are evenly graduated. For measuring water, or fluids having approximately the same specific gravity, ranges vary from 0-150 gal. per hour minimum, to 0-2,000 gal. per hour maximum. Only in 2-in. pipe size.—*Brown Instrument Co., Philadelphia, Pa.*

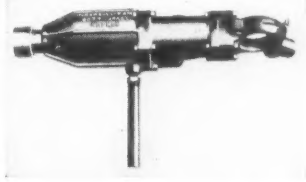
Isometric Sketch Paper

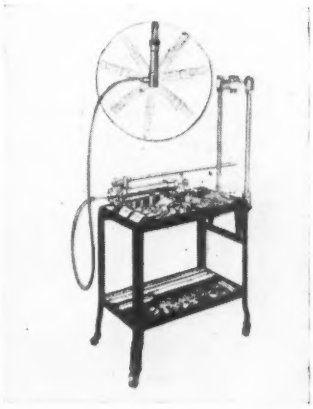
FOR quick, easy sketching of three-dimension drawings, all axes spaced 1-in. and subdivided ¼ in. Double line "Y" shows center and isometric principle at a glance. Guide lines in green. Two sizes, 8x13-in., and 4x6½-in., pocket size, larger in 40-sheet pads, smaller in 100-sheet pads. — *Wade Instrument Co., 2274 Brooklyn Station, Cleveland, Ohio.*



Pneumatic Wrench

POTT impact wrench weighs about 20 lb., and will spin down 1-in. or larger nut at 700 r.p.m., and give it a series of smart torsional blows at 1,400 per min. to tighten it as securely as desired. Possible to remove nuts formerly not removable, except by splitting or burning. Operable by one man. — *Ingersoll-Rand Co., 11 Broadway, New York, N. Y.*





MISCELLANEOUS EQUIPMENT

Gaskets

COMPOSED of corrugated metal core covered by layer of woven asbestos metallic cloth, these gaskets are especially suitable for boiler manholes and handhole plates.—*Goetze Gasket & Packing Co. Inc., New Brunswick, N. J.*

Packing

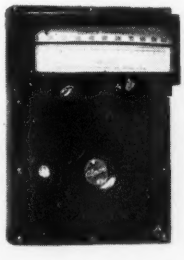
"STAPAX" semi-metallic, semi-plastic packing in loose form for stuffing boxes and coiled for valve stems and rods. Contains metal alloy for wear, and asbestos, impregnated with solid lubricant, besides other ingredients for elasticity, moldability and to resist acids. Coil form in sizes from 3/16 to 1¼ in. wide. —*Rhodes Packing Co., Chatham, N. Y.*

Rustproofing Process

PROTECTS steel surfaces by dipping or spraying with Cromodine for 1 min. — *American Chemical Paint Co., Ambler, Pa.*

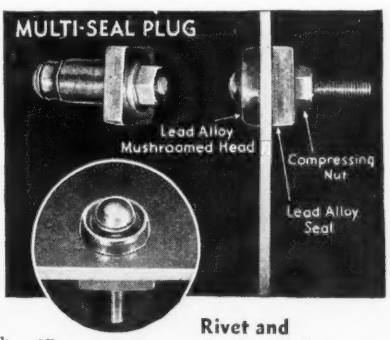
Industrial Cleaner

WEIGHS 40 lb. Removable motor unit for quick changeover to blowing. Universal 1-hp. motor, either 110 or 250 volts, and 7-in. fan, to create vacuum of 46¾ in. of water. When used as blower, fan delivers stream of dry air at nozzle 25,200 cu.ft. per min. Standard attachments. Also special attachments. — *Ideal Commutator Dresser Co., 1554 Park Ave., Sycamore, Ill.*



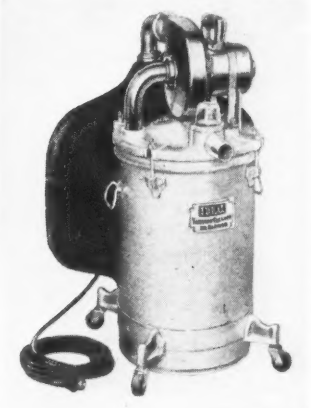
Horizontal Edgewise Pyrometer

"ALNOR" pyrometer with or without multi-point switch, as desired. With switch, can be obtained either with 8, 17, 18 or 25 points. Damper avoids overswing or oscillation; full 6-in. scale for accuracy, waterproof case, also fume and dust-tight.



Rivet and Anchor Bolts

"MULTI-SEAL" will rivet sheet metal from one side of job. Forms three seals and withstands 2,000-lb. pressure. Has fusing point of 900 deg. F. Four sizes—¼ in. (fills ¼-in. hole), ⅜ in. (fills up to ⅝-in. hole), ½ in. (fills up to ¾-in. hole) and 1 in. (fills holes up to 2 in.).—*Multi-Seal Mfg. Co., 7755 Sheridan Rd., Chicago, Ill.*)

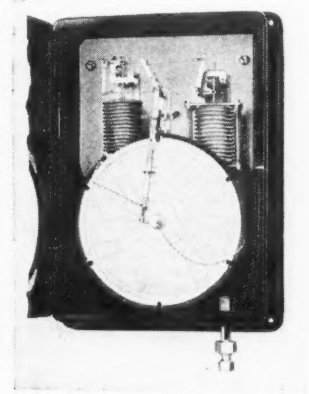


Portable Hydraulic Jack

"PORTO-POWER" jack is a 7-ton remote-control hydraulic power ram. Compact and portable outfit. Also a number of auxiliary parts and accessories. — *Blackhawk Mfg. Co., Milwaukee, Wis.*

Finishes

BASE of vegetable gums and heat-treated oils. Non-porous and impervious to water and corrosive gases. Applicable to wood, dry concrete, plaster, etc. Primers with non-porous base available. Drying time 4 to 16 hr. — *Technical Coatings, Inc., 9-15 Park Place, New York, N. Y.*

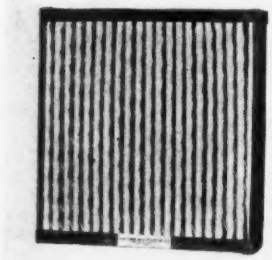


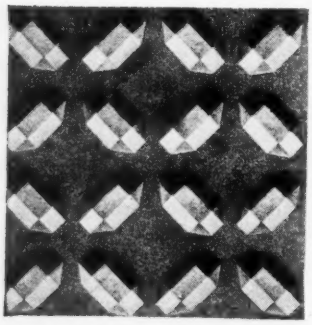
Recording Absolute-Pressure Gage

ONE element connected to vacuum line, other functions in connection with compensating element. Ranges as low as 25 mm. head of mercury abs. or equivalent. Rectangular wall or flush case.—*Bristol Co., Waterbury, Conn.*

Dry-Type Air Filter

"AIRFLEX" dry cartridge filter is specially processed cotton, pleated back and forth 80 times to give over 30 sq.ft. of filter material in a frame 20x20x4 in.— *Davies Air Filter Corp., 390 Fourth Ave., N. Y.*



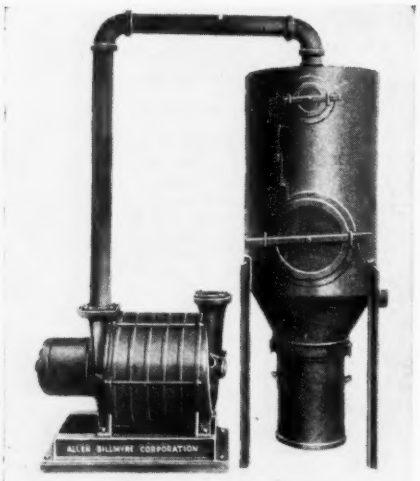


Steel Floor Plate

MULTIGRIP floor plate has surface to give high degree of skid resistance from every angle, with greater comfort under foot. All lugs have flattened top surface. Cleaned readily and drains freely. Standard weights and sizes from $\frac{3}{16}$ to $\frac{1}{2}$ in. thick, with maximum 84 by 480 in.— *Illinois Steel Co., 208 South La Salle St., Chicago, Ill.*

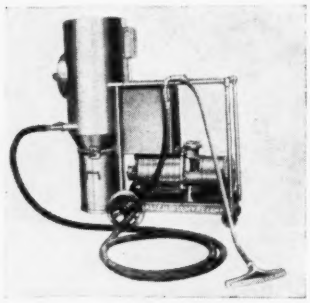
Stationary Vacuum-Cleaning System

MODEL FB driven through flexible couplings from either a.c. or d.c. 50- or 60-cycle motors or steam turbines. Belt drive available. Consists of centrifugal exhauster, separating system composed of one or more large tanks, set of cleaning tools, flexible suction hose, piping system. — *Allen Billmyre Corp., South Norwalk, Conn.*



Portable Vacuum-Cleaning System

EXHAUST heavy-duty Model MOH (illustrated) in six sizes with $1\frac{1}{2}$ to 10-hp. motors built in. Utilize 2- or 3-phase, 60-cycle a.c. Impellers aluminum alloy 1-piece castings, balanced. Truck chassis of welded tubular steel. Also in medium-duty model in two sizes and heavy-duty model FB in six sizes.— *Allen-Billmyre Corp., South Norwalk, Conn.*

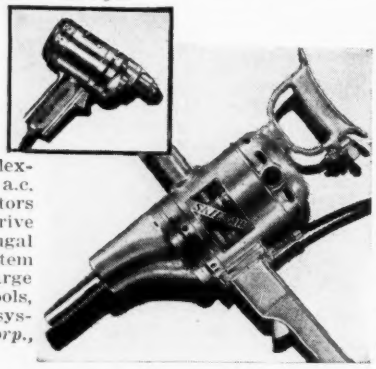


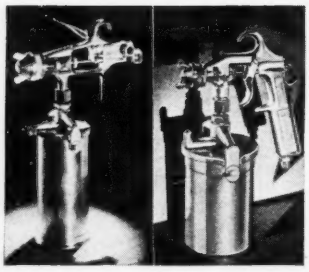
Goggles

DURALITE-50 hot-worker's goggle doubles area usually allowed for ventilation. Special lenses and frames.—*American Optical Co., Southbridge, Mass.*

Electric Drill

Two small sizes, $\frac{3}{16}$ and $\frac{1}{4}$ in., Speeds 2,000 to 2,700 r.p.m. Also three large models, $\frac{5}{8}$, $\frac{3}{4}$ and $\frac{7}{8}$ in. —*Skilsaw, Inc., 3345 Elston Ave., Chicago.*





Paint Spray Gun

"THOR" Models 5 (left) and 6 have spray adjustable while in use. No. 5 for touchup and shading, No. 6 for touchup and general service. No. 5 has overhead trigger; No. 6 conventional pistol grip. — *Binks Mfg. Co., 3140 Carroll Ave., Chicago, Ill.*

Goggles

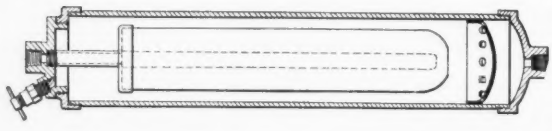
F3100 SUBSTITUTES pearl full-rocking nose-pads. Flexible cable earpieces, completely insulated. "Ful-Vue" goggle fitted with 6-curve "super armor-plate" lenses. — *American Optical Co., Southbridge, Mass.*

Chemical Goggles

SIMILAR to Duralite-50 hot-worker's goggle. Slight changes in design to adapt it for chemical use.—*American Optical Co., Southbridge, Mass.*

Air Filter

FILTER element is a hollow candle of diatomaceous earth. Positive air purification. 8 and 16 c.f.m. $\frac{1}{4}$-in. pipe connection. 5 to 7-lb. pressure drop. Porosity can be controlled. Sanded when it becomes coated. Free test.— *Clean Air Filter Co., 1440 Broadway, New York, N. Y.*

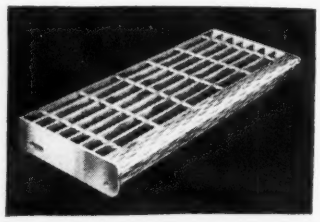


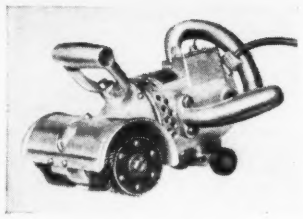
Safety Signal

AUTOMATIC types. Hook for lantern, socket for flag or flare, sets firmly on $2\frac{1}{2}$-ft. triangular base. Special signs may be quickly snapped on stem. Folds to fit tool box. Also drive-type with driving weight mounted. 23 15-in. sq., baked yellow-enamel signplates with different standard legends; also blanks for special lettering. 15x18-in. red flags. — *Martindale Electric Co., Box 2669, Lakewood Branch, Cleveland, Ohio.*

Stair Tread

ELECTROFORGED stair tread for strength against impact. Nosing of rolled diamond-checkered plate. Intersections of bars electroforged without removing any metal. Avoids loose parts or tendency to rattle. — *Blaw-Knox Co., Pittsburgh, Pa.*





Steel-Cleaning Tool

MODEL "M" "Berg" cleans off heavy rust, scale and foreign accumulations, cuts down through pitted cavities. 72 loose cutters thrown out by centrifugal force at 115,000 impacts per minute. Degree of impact regulated by a depth shoe easily adjusted. Electric unit illustrated has G.E. $\frac{1}{2}$-hp. universal motor, grease-seal ball bearings, similar accessories. — *"Berg" Cleaning Tool Division, Concrete Surfacing Machinery Co., Cincinnati, Ohio.*

Rubber Protective Coating

"KELSANITE" can be applied by spraying. Used to prevent rust in storing metal parts, for absorbing dirt or moisture on surface being coated, and as masking compound for plating or metal spraying.—*Kelsan Products, St. Clair, Mich.*

Sealing Compound

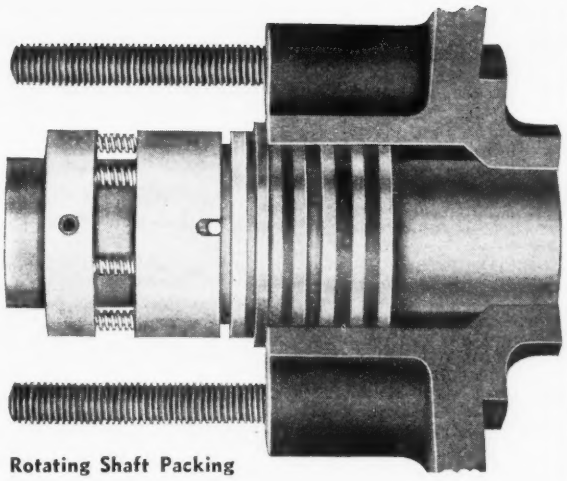
"TITESEAL" in three densities, light weight for fine joints; medium weight for general gasket use; heavy for heavy gasketing, general calking, etc. Tube or can.—*Fostoria Pressed Steel Corp., Fostoria, Ohio.*

Surface Concrete Hardener

STONHARD penetrates floor surface and seals surface pores. Floor so treated stands wear 162.5% better than when untreated. — *Stonhard Co., 401 N. Broad St., Philadelphia, Pa.*

Cork Tile

LIGHT, medium and dark brown of varying shades and two thicknesses. $\frac{3}{8}$-in. thickness weighs 20 oz. per sq.ft.; $\frac{9}{16}$ in. 33 oz. per sq.ft.; and these thicknesses can be sanded down to $\frac{5}{16}$ in. and $\frac{1}{2}$ in. where required. Also coved angle and wall base, as well as special heavy-density Corinco cork tile nosing for stairways. — *Cork Insulation Co., Inc., 155 East 44 St., New York, N. Y.*



Rotating Shaft Packing

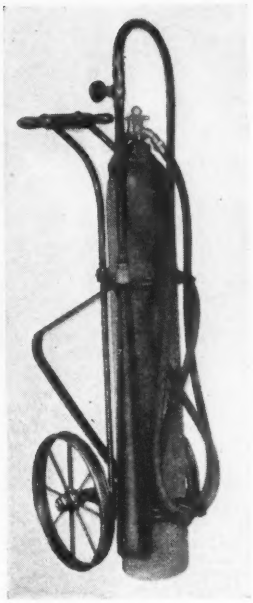
"DURASEAL" seals pumps, exhausters, etc., working gritty and/or corrosive liquids and gases. Can be applied to ordinary stuffing boxes. On moderate pressures outside assembly (illustrated) is used. Bushing in stuffing box remains stationary. Flexible metallic or other suitable packing is applied in grooves or bushings to prevent leakage along stuffing-box wall. Actual packing or rotating member is outside stuffing box. On higher pressures, member which rotates with shaft is placed within stuffing box and revolves against a special stationary bushing. Variety of materials to suit conditions.—*Durametallic Corp., 2108 Factory St., Kalamazoo, Mich.*

Non-Corrosive Castings

S MONEL, similar in analysis to Monel, but having higher maximum silicon content (3.75% max.), thus higher hardness and greater resistance to wear and corrosion, particularly from steam. Non-galling, especially at high temperatures. Harder grades must be softened for machining, then heat-treated. Tensile strength 100,000 to 120,000 lb. per sq.in., yield point 90,000 to 100,000 lb. per sq.in. Another grade of Monel has hardness of 225 to 250 Brinell and silicon about 2.5%.—*International Nickel Co., Inc., 67 Wall St., New York, N. Y.*

Gasket-Cutting Tools

FOR making gaskets, shims, templates, etc., from sheet packing and other materials, this set of tools consists of five hollow center punches, ¼ to ¾ in., one 6-in. scratch awl and pair of 7-in. form-cutting snips. Other sizes.—*Goetze Gasket & Packing Co. Inc., New Brunswick, N. J.*

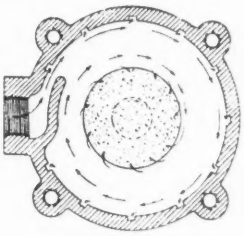


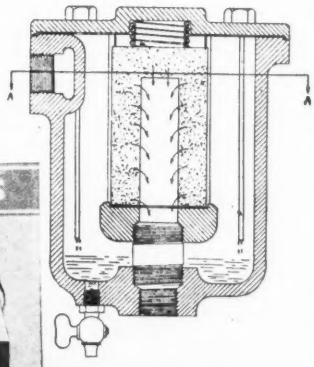
Calculator and Function Table

"TRIGONOGRAPH" based on "unit circle principle" has movable hypotenuse attached to 45-deg. right triangle, both decimally divided. Moving hypotenuse through an angle graphically indicates to two or three places, ratio between sides of right triangle. Auxiliary scale for oblique triangles. Celluloid or cardboard.—*Chemical Rubber Publishing Co., 1900 West 112th St., Cleveland, Ohio.*

Air Filter and Separator

ALUMINUM-OXIDE crystals and ceramic bonding material in tube form vitrified at 2,372 deg. F. in combined unit with porosity equal to 38% of total material volume. Air throws off into vertical slots any entrained oil, water, etc., as it circulates





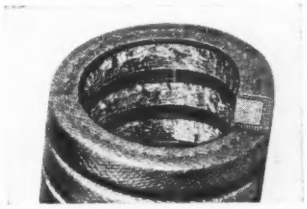
outside. Approaching inner axis of filter, it slows down and passes through renewable porous filtering element.—*R. P. Adams Co., Buffalo, N. Y.*

Fire-Fighting Equipment

To combat fires in highly inflammable liquids and for grease and electrical fires, "C-O-TWO" equipment is non-freezing. Portable, hose and truck types, latter illustrated. Units sealed against leakage and have shutoff valve for maneuvering around fire. Approved by Underwriters Laboratories.—*C-O-TWO Fire Equipment Co., Pyrene Bldg., Newark, N. J.*

Semi-Metallic Packing

COMPOSED of insert of thin ribbons of soft babbitt foil, formed so that edge of foil contacts



moving surface of rod on which it is used, "John Crane, Style 300, Edge-On" packing recommended up to 450 deg. F.—*Crane Packing Co., 1801 Cuyler Ave., Chicago, Ill.*

Circular Slide Rule

VEST-POCKET "Mascot," 2¾-in. in diameter, gives squares, roots, logarithms and reciprocals. Trig scale gives sines and tangents.—*Tavella Sales Co., 25 W. Broadway, New York, N. Y.*

Insulating Cement

"SONITTEP" is unaffected by temperatures up to 2,000 deg. F. Will stick to hot or cold surfaces, requires no reinforcement, is not loosened by vibration and shock. May be troweled to smooth finish; no finishing coat required. Can be used for refrigeration or heat insulation. Prevents air infiltration and is soundproof.—*Geo. F. Pettinos, Inc., 1206 Locust St., Philadelphia, Pa.*

Pull-Lift Tool

LIGHT-WEIGHT. May be used in either horizontal or vertical position. Will lift up to 6 tons. Made in ¾-, 1½-, 3- and 6-ton capacity. Called "Pul-Lift."—*Yale & Towne Mfg. Co., Philadelphia, Pa.*

Electric Drill

⅜-IN. ball-bearing electric drill has special high-power motor in die-cast aluminum-alloy body. Free speed is 500 r.p.m. Jacobs chucks.—*Skilsaw, Inc., 3310 Elston Ave., Chicago, Ill.*

Zinc-Chromate Primer

BERRYLOID is corrosion-inhibiting primer for all metal surfaces including aluminum. Dries more rapidly than pyroxylin, primer, yet has adhesion and waterproofing qualities not obtainable in lacquer-base primers. Can be thinned 300% for spray. Mixed with aluminum powder, it can be used as a dope-proof paint and sealer to prevent bitumastic from bleeding into finish coats.—*Berry Brothers, Inc., 211 Leib St., Detroit, Mich.*

Paint Protector

"TRIPLE LIFE" protector provides highly resistant coating on surfaces which tend to oxidize.—*Franklin Research Co., 5134 Lancaster Ave., Philadelphia, Pa.*

Improved Air Filter

"DUSTOP" is fire-resistant, lower in air resistance. Series of coarse and fine mats of glass fibers, bonded to each other to form semi-rigid mat. Adhesive has high dirt-holding capacity and surface tension four times that of engine oil, which means no oil vapor is entrained in air stream.—*Industrial Materials Division, Owens-Illinois Glass Co., Toledo, Ohio.*

Spiral Leather Jacking

100-FT. coils, in ½-in. and ¾-in. widths in five diameters from 6 to 16 in. Can be wound on rams of any size between these diameters and larger. Material is "Thermo" leather, claimed not to swell or shrink.—*C. W. Marsh Co., Muskegon, Mich.*

Quick-Setting Acidproof Cement

SAUER-EISEN No. 21 will set in 36 hr. Mixed with water hardens to procelain-like structure resistant to water, fumes and many solvents, also fire. Will stand 2,500 deg. F. Initial "set" in 1 hr.—*Technical Products Co., Pittsburgh (15), Pa.*

High-Speed Oil Seal

SIZES ¾ to 4 in. diameter by $\frac{7}{32}$ in., two styles, DM with flange and DP without flange. Seal consists of housing, diaphragm and seal ring of special bronze. Diaphragm clamped to housing and seal ring and is heat-resisting to 220 deg. F. constant or 275 intermittent.—*Gits Bros. Mfg. Co., 1846 S. Kilbourn Ave., Chicago, Ill.*

Electric Hammer and Drill

"Do-All" is primarily an electric hammer which, with simple adjustment, may be used as electric drill, light grinder and buffer. Hammer mechanism has only two working parts. — *Wodack Electrical Tool Corp., 4627 W. Huron St., Chicago, Ill.*

Swivel-Head Cutter

HKP CUTTER cutting head swivels to any angle on either side of handles. Special section joined by ball-and-socket joint, with shoe for holding cutter-head and positioning spring. Shoe will hold any standard head interchangeably. — *H. K. Porter, Inc., Everett, Mass.*

Noiseless Electric Crane

HERRINGBONE gears running in oil, forced lubrication on hoisting train and mechanical brake, Hyatt roller bearings throughout in "Tiger" crane. — *Whiting Corp., Harvey, Ill.*

Rubber Substitute

"KoraSeal" may be varied from hard to soft doughy consistency, and molded into any shape, is odorless, and of many colors. Resists swelling under oil and greases, and corrosive chemicals. Piston packing. — *Mechanical Division, B. F. Goodrich Co., Akron, Ohio.*

Rubber Covering

"Self-Vulc," in liquid or plastic form, vulcanizes itself when exposed to air. Applied after one coat of priming. Used to resist abrasion, corrosion and acids, to absorb shocks and to silence noises.—*Self-Vulcanizing Rubber Co., Inc., Room 515Y, 605 West Washington Blvd., Chicago, Ill.*

New Monel Metal

K MONEL combines strength of alloy steels with corrosion resistance of regular Monel. 4% aluminum and fractional amounts of other elements added. Readily heat-treated to above 350 Brinell. Tensile above 160,000 lb. per sq.in.— *International Nickel Co., Inc., 67 Wall St., New York, N. Y.*

Sealing Compound

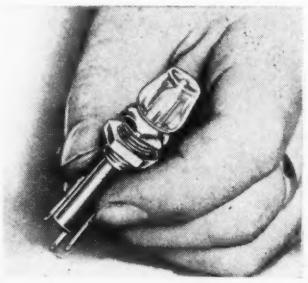
FOR screw-threaded, flanged and gasketed joints, "Plastiseal Expanding Joint Compound" has chemically inert vehicle and mineral base. "Aquaseal" for water, gas, air and low-pressure steam lines. 1, 5, 10 and 30 lb. containers.—*Goetze Gasket & Packing Co., Inc., New Brunswick, N. J.*

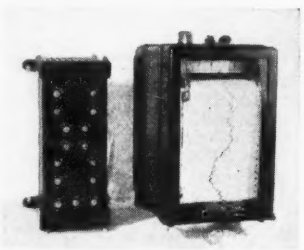
Natural Zeolite

"Hi-Inversand" combines high exchange value of synthetic zeolite with durability of greensand. With 1½ lb. of salt, 4,000 to 4,200 grains of hardness can be removed. Can be used in open-type gravity softeners, or in pressure type. Also sold under name "Hi-Basex."—*Hungerford & Terry, Inc., Clayton, N. J.*

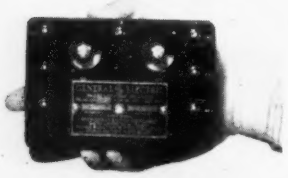
Neon Pilot Light

"INDICATOR TATTELITES" operate on standard commercial voltages (90-250) a.c. or d.c., to tell when electric unit is operating. Consume about 1/1000 amp. Unaffected by vibration and have 3,000-hour life.—*Littlefuse Laboratories, 4507 Ravenswood Ave., Chicago, Ill.*





MOTORS, ELECTRICAL AND ELEVATOR EQUIPMENT



Phase-Rotation Indicator

FOR 3-phase work. Has no moving parts. Weighs 12 oz. and is 5½x3½x3 in.—*General Electric Co., Schenectady, N. Y.*

Fire-Proof Elevator Cable

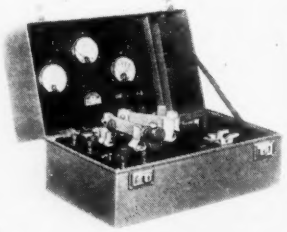
FIRE-PROOF, multi-conductor cable resists moisture, flame, oil and corrosive vapors. Any length; up to 37 conductors. Conductors color-marked, and individual conductors cabled together with fire-resisting fillers. —*General Electric Co., Merchandise Dept., Bridgeport, Conn.*

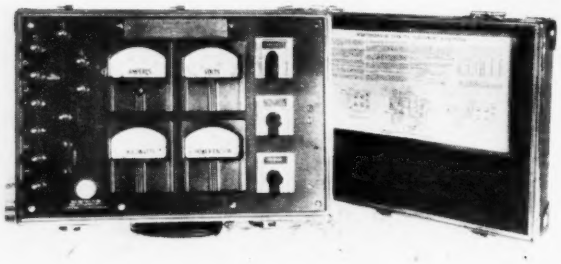
Tester

"INDUSTRIAL ANALYZER" has additional testing-capacity instruments with knife-edge pointers and fine-line scale divisions, increased voltage range to 575 volts. Over-all accuracy within 1% for ammeter and voltmeter, and 20% for wattmeter. Unit is miniature switchboard panel, complete carrying case with all switching equipment; including triple-scale ammeter 0-5, 0-25 and 0-125 amp., triple-range voltmeter 0-150, 0-300 and 0-600 volts, polyphase wattmeter with three scales for above voltage and current ranges, and polyphase p.f. meter with 10-100-80 scale to operate on the above voltages and currents.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Circuit Tester

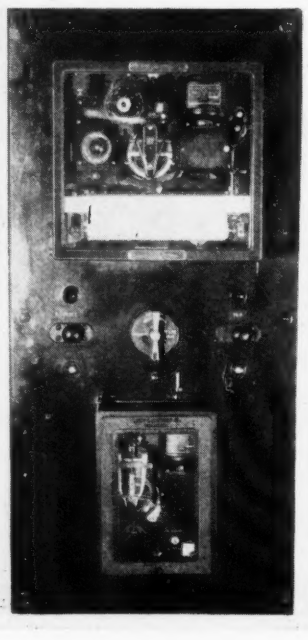
MODEL 3DA portable volt-ampere meter combination requires no external shunts or multipliers and reads direct. Adapted to measuring currents and voltages on circuits from ½ kw. to 100 hp.





Load-Frequency Regulator

THIS system will tie one company's facilities in with another's for specified number of minutes to care for abnormal load swings, then return to usual tie-lines. Will also keep definite loads on tie lines despite load swings on either system, and allows each company to assist in frequency regulation, yet handle own load fluctuations. Will also hold single or interconnected stations constant. — *Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa.*

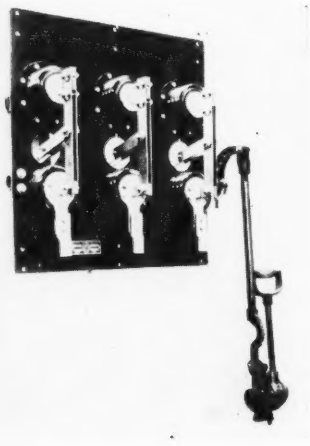


Graphic Recording Kva. Meter

STANDARD Model A.W. wattmeter with phase-shifting network to supply wattmeter with lagging potential corresponding to average p.f. of circuit. By means of three sets of taps, unit is made to cover a range of p.f. from 0.45 to 0.94 with error not to exceed 1½%. By omitting network, instrument can be used as graphic wattmeter. Supplies in combination 100-200 volt range. Wide variety of ranges and chart speeds. Charts uniformly divided and 94 ft. long. — *Esterline-Angus Co., Indianapolis, Ind.*

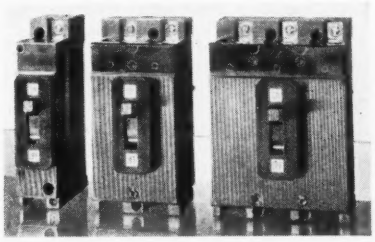
Disconnecting Switches

THREE-POLE, indoor disconnecting switches with tongue-type contacts, double blades and operating mechanism which can be locked either open or closed. Type "3CJH-34", 7.5-kv., 400-amp. switch pictured. Top insulator is of back-connected bushing type, lower front-connected.—*Delta Star Electric Co., 2400 Block, Fulton St., Chicago.*



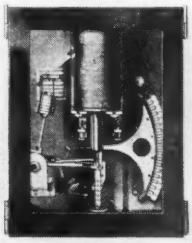
Small Circuit Breaker

ITELITE in capacities suitable for protection of commercial wire sizes from 15 to 600 amp., and voltages up to 250 d.c. and 600 a.c. Includes single, double and 3-pole bi-metallic thermal element, de-ionizing arc quencher. —*I-T-E Circuit Breaker Co., 19th & Hamilton Sts., Philadelphia, Pa.*



Voltage Adjuster

"VI" can be applied to a.c. generators from 5 kva. at 360 r.p.m. to 250 kva. at 3,600 r.p.m., where requirements are not too exacting. 8⅞ in. wide 11 in. high and 9⅜ in. deep. "Rocking contact" design.—*Allis-Chalmers Mfg. Co., Milwaukee, Wis.*



Generator-Voltage Regulator

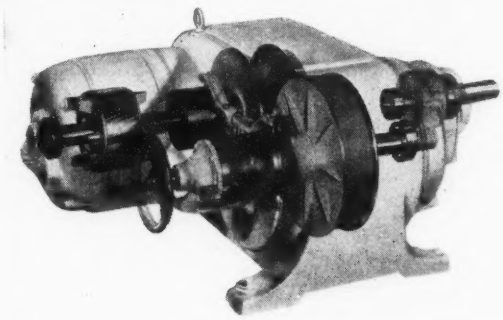
FOUR types of exciter-field rheostatic units, Types GDA and and GFA-4 for application to a.c. units, Types GDD and GFD-2 for d.c. GFA and GDD are direct-acting, i.e. have rheostatic element as integral part of regulator unit, actuated directly by voltage-sensitive regulating device. In GDA and GDD, dashpot linked to moving element prevents oscillation and provides dead-beat operation. Other two types have magnetic damping device.—*General Electric Co., Schenectady, N. Y.*

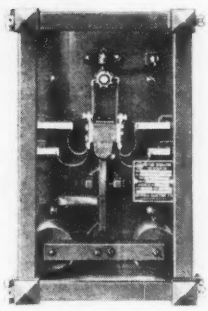
Solenoid Switch for Hazardous Dust

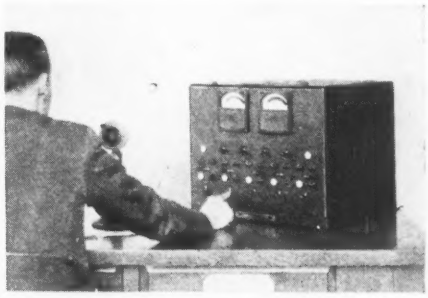
TYPE D dust-tight enclosures for Allen-Bradley 709 starters in polyphase ratings up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440-550 volts, also single-phase motors of self-starting type.—*Allen-Bradley Co., 1311 S. First St., Milwaukee, Wis.*

Automatic Supervisory System

OPERATES over two wires and supervises five substations. Permits opening and closing of circuit breakers with indication of their position; starting and stopping of machines with indication of their condition; raising and lowering of speed, voltage, or gaes; obtaining of meter readings; and telephone conversations and calling.—*General Electric Co., Schenectady, N. Y.*







Variable-Speed Motor

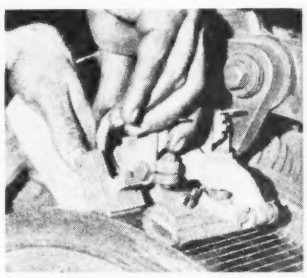
"VARIDRIVE" motor has new lever-arm construction for larger horsepower ratings. Combines constant-speed motor, variable-speed device and gear case in unit. Eliminates mounting bases, transmission, etc. Unit can be direct-connected to the driven machinery. — *U. S. Electrical Mfg. Co., 1579 S. Western Ave., Chicago, Ill.*

Weatherproof Line Wire

VARNISHED cambric and weatherproof braid treated with U.R.C. compound has solid or stranded copper conductors, depending on size. Has two wraps of 0.010-in. varnished cambric in size from No. 20 A.W.G. to 500,000 c.m., and three wraps from 600,000 to 2,000,000 c.m.—*General Electric Co., Schenectady, N. Y.*

Anchor Tap

HIXLEY tap permits mechanical joining of cable, and in addition provides a cable support where necessary. Its full-floating feature permits flexibility, allowing for entrance of main cables at other than right angles.—*Trumbull Electric Mfg. Co., Plainville, Conn.*

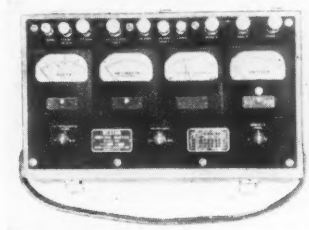


Brush Seater

FOR seating carbon, graphite or metal-composition brushes. Does not scratch commutator, but does polish it. Friction from commutator or ring releases brush-seater material which is carried under brush and picked up on pad on opposite side. Standard size 4⅜ in. long x 1¼ in. wide x ⅝ in.—*Ideal Commutator Dresser Co., 1005 Park Ave., Sycamore, Ill.*

Blown-Fuse Indicator

"DED-FUSE TATTLELITE" is a tiny neon lamp and casing designed to tell instantly when and where a fuse is blown. Connected directly in parallel with fuse, and draws no current until fuse has blown. For circuits of 100 to 550 volts a.c. or d.c. Protective resistance built in.—*Littlefuse Laboratories, 1772 Wilson Ave., Chicago, Ill.*



Load Tester

MODEL 639 is self-contained to measure current, voltage and power in single and polyphase circuits, as well as power factor in 3-phase circuits. Detects overloaded or underloaded motors. Combines Weston Model 610 voltmeter, wattmeter, power factor meter and ammeter, latter with an adjustable pointer stop.—*Weston Electrical Instrument Corp., Newark, N. J.*

Drop-Out Fuse Disconnect

TYPE EF-2 includes standard G-E Type EG-1 fuse. When fuse blows, latch is released and switch drops to 60-deg. position. When switch is opened manually it drops to 180-deg. disconnect position. Standard NEMA voltage ratings from 7,500 to 69,000 volts. Fuse with ratings of potential transformers and up to 200 amp. size.—*General Electric Co., Schenectady, N. Y.*

Portable Test Units

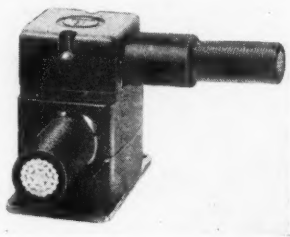
THIS line of portable volt-ohmmeters and test units are equipped with d'Arsonval movements and selector switches. Simple ohmmeters, volt-ohmmeters, d.c. test units and more elaborate multiscale a.c.-d.c. test units. Accuracy within 2% for d.c. volts and milliamperes, and within 5% for a.c.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

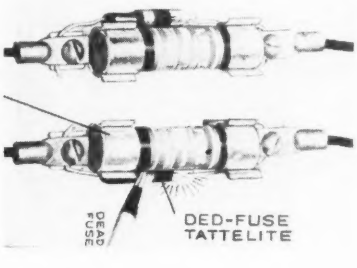
Paper-Insulated Cable

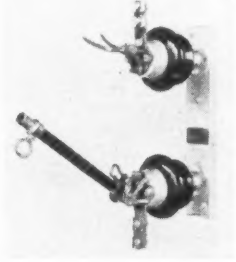
COMPACT-STRAND conductor reduces cable diameter, gives higher dielectric strength, lowers a.c. resistance, and gives longer life. Segmented construction instead of former annular design increases current-carrying capacity for a given diameter. Layers of insulation graduated with "super-dense" paper next to conductor improve mechanical and dielectric strength.—*General Electric Co., Schenectady, N. Y.*

Convertible Motors

SQUIRREL-CAGE and slip-ring induction motors in all standard frequencies, 110-220 volts. Built to N.E.M.A. standards, readily convertible to open or fan-cooled, splash-proof or totally enclosed types. ½ hp. 600 r.p.m., to 126 hp. 3,600 r.p.m.—*Harnischfeger Corp., West National Ave., Milwaukee, Wis.*





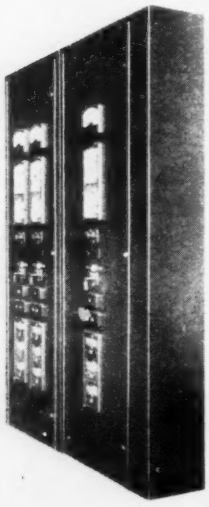


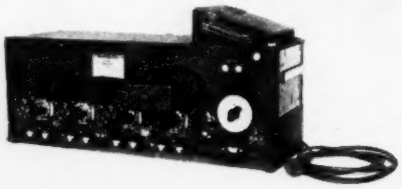
Switchboards

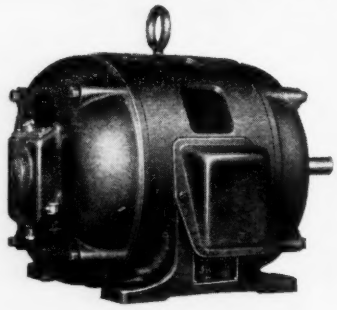
"STREAMLINED" steel switchboards have all devices built in. Instruments project about an inch from panel front.—*General Electric Co., Schenectady, N. Y.*

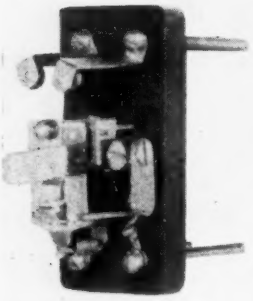
Universal Oscillograph

VARIETY of interchangeable control panels. Type PA unit offers simultaneous viewing of phenomena while photographing. —*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*









Polyphase Motors

THESE squirrel-cage normal-torque and high-torque motors are especially designed for refrigeration and air conditioning on units including latest Freon compressors. Sleeve or ball-bearing design, 600 hp. and smaller. — *Century Electric Co., 1806 Pine St., St. Louis, Mo.*

Plug Fuses

"BLAC-LINK" plug fuses have black link and white interior to detect blown fuses. — *Chase-Shawmut Co., Newburyport,*

Reset Relay

MECHANICAL-LATCH, manual-reset relay for signal service, will allow operator to disconnect signal yet have circuit return to normal when need for signal has passed.—*Struthers & Dunn, Inc., 139 North Juniper St., Philadelphia, Pa.*

Voltage Regulator

THIS vibrating-contact type unit is for maintenance of close voltage regulation in a.c. generator installations. No dashpots or other damping or retarding devices. Suitable for use with units of capacities from 1 to 5,000 kw.—*Simplex Corp., Burlington, Iowa.*

Time Switches

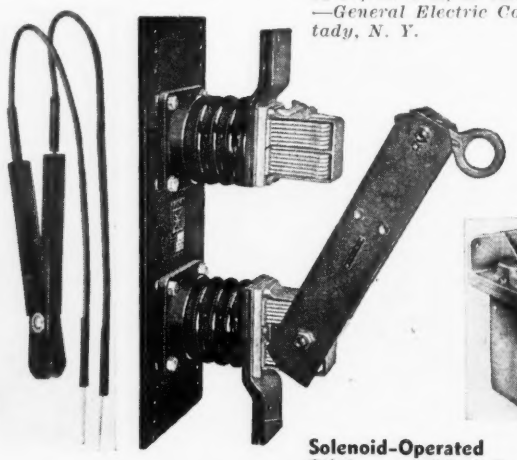
TYPES T-17 and T-27 will perform any practical number of operations per day and can be set to skip one or more days. Standard switches for a-c circuits, 115 and 230 volts, 40 amps. per contact. Triple-pole switch will handle 120 amps. split load. Type T-27 for indoor service only. Telechron motor drive through spur-gear train. Switch operated by small riders clamped to periphery of time dial which engage tripping lever. Index indicates switch position. Six forms: single-throw, single-, double-, and triple-pole; double-throw, single- and double-pole; and two-circuit with separate break. — *General Electric Co., Schenectady, N. Y.*

Test Light and Fuse Puller

18-IN. FLEXIBLE leads. Will test circuits of 110 to 550 volts, and will test, remove or replace fuses from 30 to 100-amp. capacity. Molded reinforced Bakelite 7 in. long and weighs 6 oz. Test pins mounted in handle ends. Test light in one handle. Either one or two leads with each tool.—*Ideal Commutator Dresser Co., Sycamore, Ill.*

Oil-Blast Breakers For Panel Mounting

TYPE FK-43 oil-blast breakers for panel mounting require 35% less floor space with increased reliability and reduced maintenance. Silver-to-silver current-carrying contacts. Any mounting can be used, and breakers can be operated either manually or electrically. Rated 600 amp., 15,000 volts; 1,200 amp., 7,500 volts, with interrupting rating of 50,000 kva., at rated voltage. —*General Electric Co., Schenectady, N. Y.*



Disconnect Switches *(Above)*

SOLID contacts replaced by series of wire contact fingers with hard-drawn copper wires wedged into terminal block. Contact wire has rolled silver insert which makes silver-to-silver contact with inlaid silver ribbon in switch blade.—*Schweitzer & Conrad, Inc., 4435 Ravenswood Ave., Chicago, Ill.*

Relays for Rectifiers

TYPE CAW induction-cylinder power relays for protecting mercury-arc rectifiers develop torque by inducing eddy currents in aluminum, cup-shaped rotors turning in annular air space inside symmetrically arranged magnetic poles.—*General Electric Co., Schenectady, N. Y.*

Battery-Cell Tester

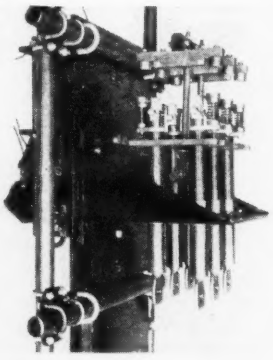
TUNGAR battery-cell tester for usual high-rate-discharge tests or open-circuit tests has molded prod-handle shaped body with meter at top of handle imbedded in rubber guard. Thumb-screw type switch located between two cadmium-plated battery prods.—*General Electric Co., Schenectady, N. Y.*

Solenoid-Operated Oil-Immersed Switch

TYPE H (explosion-proof) and Type J (general application) inclosures for sizes 2 and 3 switches of Bulletin 709 solenoid-operated across-the-line starters. Starters equipped with these inclosures will take care of any polyphase motor requirements up to 15-hp. 110 volts, 30-hp., 220 volts and 50-hp. 440-550 volts, as well as self-starting, single-phase motors.—*Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.*

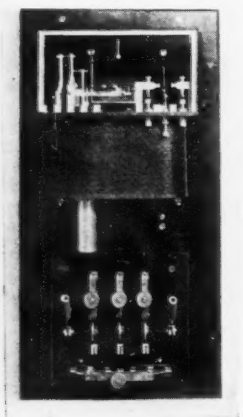
Oil-Blast Circuit Breaker

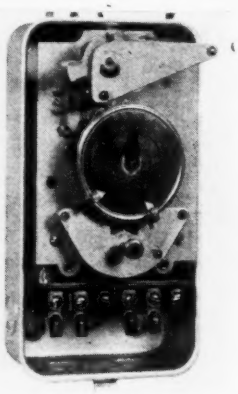
TYPE FK-42 is rated at 600 amp., 7,500 volts; 800 amp., 2,500 volts, and 25,000 kva., interrupting rating. All designs double and triple-pole single-throw. May be mounted directly back of panels or in switch houses or metal-inclosed switchgear. Manually or electrically operated.—*General Electric Co., Schenectady, N. Y.*

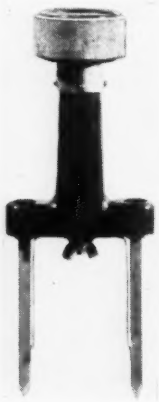


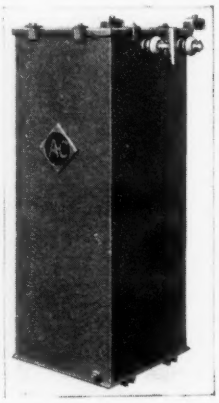
Branch Feeder Regulator *(Cut at left)*

TYPE BFR regulator covers 100% range in eight 1¼% steps. Standard sizes from 5 to 200 amp., 2,400 to 13,200 volts in single and 3-phase. — *Allis-Chalmers Mfg. Co., Milwaukee.*







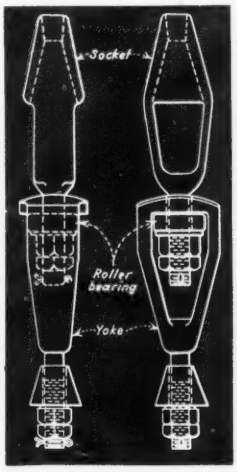


Small-Motor Temperature Indicator

DEVICE called "Ideal Tel-Temp" employs bimetallic principle and consists of dial plate mounted in dustproof aluminum case protected by non-breakable crystal and chromium-plated cap. Temperature readings from 0 to 100 deg. C.—*Ideal Commutator Dresser Co., 1813 Park Ave., Sycamore, Ill.*

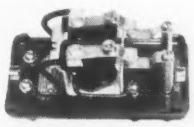
Roller-Bearing Shackle For Governor Ropes

FITTED with tapered roller bearings, Culp shackle provides for rotation of elevator governor ropes to distribute wear evenly over their whole area. Socket and yoke are malleable chrome-nickel steel with tapered roller bearing between.—*Culp Mfg. Co., Dallas, Texas. Eastern representative, F. E. Lister, 114 W. 27th St., New York, N. Y.*



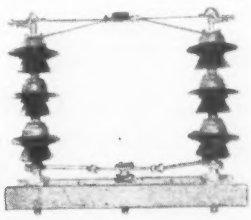
Auxiliary Relay

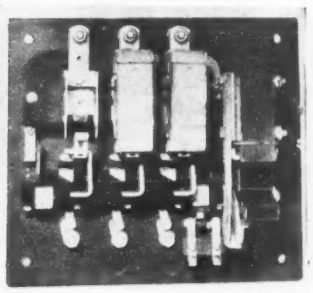
TYPE SK for switchboard mounting has molded cover or molded cover with glass front; panel-mounted unit has no cover. Continuous duty at rated voltage up to 550 volts a.c. or d.c.; ranges to 250 volts for intermittent duty up to three times continuous value. Coil supplied for current value to 5 amp.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*



Horizontal Break Switch

"PM FORM 2" switch for 115/132-S K.V. has blade of two equal lengths contacting at center point. Each half-blade carried on insulator stack on ball bearings. Blades open out on same side of switch and in full-open position are parallel to each other and at right angles to mounting base.—*Delta Star Electric Co., 2400 Fulton St., Chicago, Ill.*



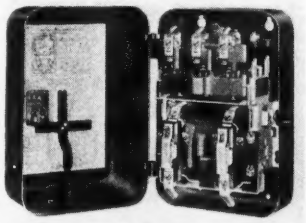


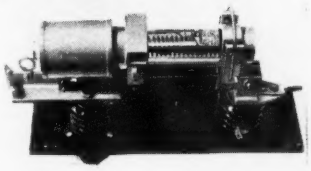
Heavy-Duty D.C. Brushes

SA-SERIES National Pyramid brushes are of electro-graphitic type for use on d.c. generators, motors, and rotary converters. Five grades: SA-25, SA-30, SA-35, SA-40 and SA-45, covering an extremely wide range of applications.—*Carbon Sales Division, National Carbon Co., Cleveland, Ohio.*

Motor Starter

TYPE A-32 across-the-line motor starter rated at 25 hp. at 440 and 550 volts, 15 hp. at 220 volts, and 7½ hp. at 110 volts, is furnished for remote control.—*Condit Electrical Mfg. Corp., Hyde Park Station, Boston.*





Fuse

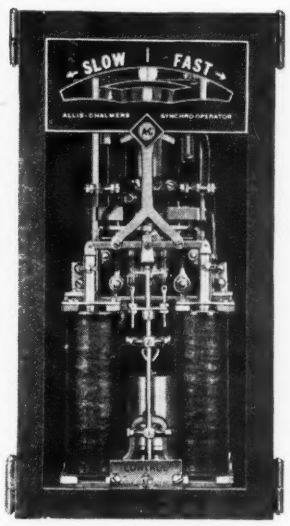
TYPE C fuse where blowing of expulsion-type fuses might cause damage, has heavy arcing chamber and condenser chamber at top. Capacities ½ to 400 amp. for 7.5-, 23- and 34-kv. systems.—*Schweitzer & Conrad, Inc., 4435 Ravenswood Ave., Chicago, Ill.*

Automatic Recloser

MOTOR-OPERATED, Type RC, timing recloser has integrating lockout device. For breakers with full-automatic mechanism, initial immediate reclosure is obtained without use of latch checking or other auxiliary devices. Lockout can be set for reclosures up to 16.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Synchronizing Device

"SYNCHRO-OPERATOR" automatic-control device combines speed matching, synchronizing and visual phase-angle indicating. Unit not much larger than usual synchroscope, can be mounted on swinging bracket. Will synchronize generator and bus even if there is a voltage difference. One operator will serve any number of generators and can be used with existing governor-control motors and circuit breakers. — *Allis-Chalmers Mfg. Co., Milwaukee, Wis.*

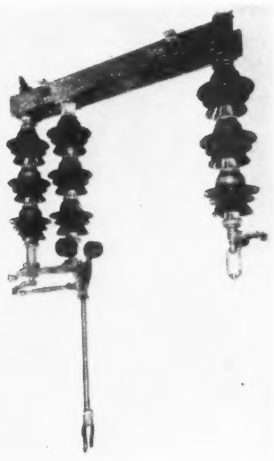


Solenoid Dust-Tight Switch

TYPE E sheet-metal enclosures on Bulletin 709 switches of sizes 2 and 3 take care of polyphase motor requirements up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440-550 volts, as well as self-starting single-phase motors.—*Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.*

High-Voltage Blade Switches

MOTOR-or manual-operated high-voltage balance-blade switches rated at 115/132 S-kv., 600 amp., assembled for inverted mounting, are so adjusted that should any link of mechanism fail it will not fall open or fly closed. Forked-blade main contact shoe is hard-drawn copper fitting within floating polished stainless-steel spring, which, with copper contact shoe, is supported by bronze casting clamped to blade.—*Delta Star Electric Co., 2400 Block Fulton St., Chicago, Ill.*



Contactors

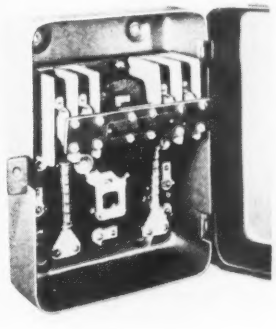
100 AND 150-AMP. "De-ion" contactors provide rolling and sliding contact on closing with high contact pressure. Shields confine flame so that electrical clearance may be reduced.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Bus Supports

FOR indoor buses and voltages up to 27 kv., reinforcing ribs of these supports can be drilled and tapped for a spacer insulator to take up short-circuit stresses between buses.—*Delta Star Electric Co., 2400 Fulton St., Chicago, Ill.*

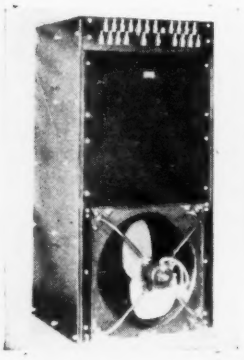
A.C. Motor Starters

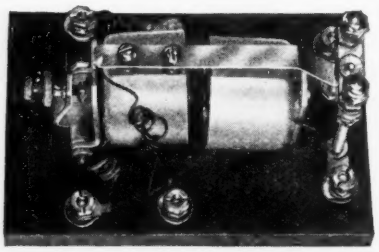
INTENDED for use with squirrel-cage motors or as primary contactor for wound-rotor motors. Automatic reset operative from button in cover, start and stop pushbutton in cover, hand-off automatic switch and reset button in cover, fusible or unfused disconnect switch. — *Monitor Controller Co., 51 S. Gay St., Baltimore, Md.*



Speed-Regulating Resistors

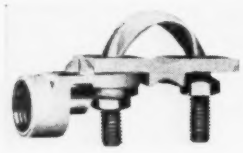
GRID boxes mounted in fan-cooled metal cabinet with terminal board on outside. For large a.c. wound-rotor motors. Grid boxes wired to provide motor speed characteristics desired, and marked terminals connected to match up with those on control panel. — *General Electric Co., Schenectady, N. Y.*

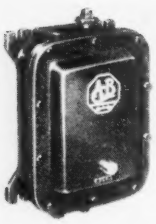




Relay Control For Charging

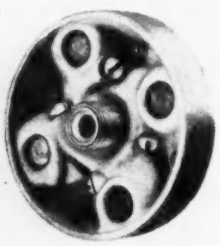
TO CONTROL charging of battery sets with three different voltages, relays are wound to pick up on 24 volts and drop out at approximately 22 volts. Resistors placed in series with coils for operation on 4 volts differential on 48 volts and 12 on 132 volts. Other types.— *Struthers Dunn, Inc., 139 North Juniper St., Philadelphia, Pa.*

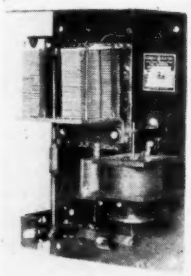




Conduit Grounding

FIXTURE box Type SP-5200B provides grounding and makes mechanical and electrical connection between box and armor. Grounding fittings, Type SP-825 and SP-826, for ½- and ¾-in. conduit have reversible shackles which fit three sizes of water pipe. U-bolt with wide, flat strap makes connection allowing conduit hub to meet pipe at any angle. Type SP-828 fitting has





connection which holds armored cable. For solderless connection, wire is hooked into groove and lug screwed tight. For soldered connection, grounding wire runs into soldering lug. — *General Electric Co., Schenectady, N. Y.*

Solenoid Water-Tight Switches

TYPE B, water-tight, weatherproof inclosures have been put on, Bulletin 709, solenoid-operated across-the-line switches having polyphase ratings up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hp. 440 to 550 volts, and for single-phase motors of self-starting types. — *Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.*

Contact-Making Voltmeters

TYPE TSB-20, for feeder-voltage regulators, responds more closely to system voltage requirements and eliminates needless operations. Iron solenoid core is suspended from compensating spring and flexibly spring-coupled to one end of a contact beam, pivoted at center. Micrometer adjustments to hold mean voltage level and regulate width of voltage band. No-voltage cutout below solenoids. —*General Electric Co., Schenectady, N. Y.*

Automatic Voltage Adjuster

TYPE G4 for use with small a.c. generators, synchronous motors or condensers and d.c. generators. Gives inexpensive regulation where voltage-regulating requirements are not too exacting. Consists of voltage-sensitive element of movable-core, solenoid type, which director operates through levers a wide range of quick-acting rheostats. —*General Electric Co., Schenectady, N. Y.*

Circuit Breakers

INCLOSED TYPE AB-F "Flipon" 15 to 50-amp. circuit breakers for protection and control of single-phase lighting and motor circuits, etc., have automatic tripping independent of manual toggle-type operation. Butt-type contacts. Thermally actuated bi-metals with inverse time lag for over-current operation. Type AB-1 "De-ion" breaker for main services, light and power systems. Four groups of ratings from 15 to 600 amp., either 250-volt a.c., 125/250 volts d.c., or 600 volts a.c., 250 volts d.c.— *Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.*

Lead-Covered Cables for 600 Volts

Two new network cables, one leaded-type for ducts, other non-metallic for 600-volt service. Leaded-type has layer of Glyptal-treated cloth covering conductor, and two layers of asbestos and one of lead over Glyptal. Non-metallic cable has Glyptal-compound sheath and rubber - compound insulation, highly moisture-resistant.—*General Electric Co., Schenectady, N. Y.*

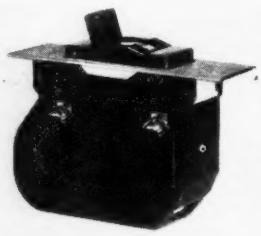
Solenoid Switch For Hazardous Gas

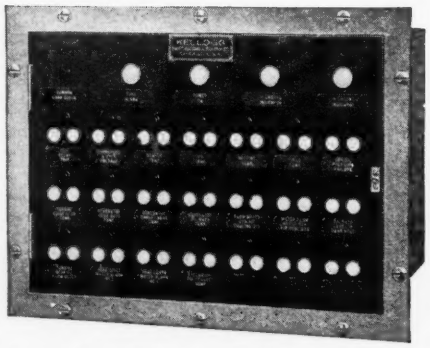
(Cut at left)

TYPE G explosion-proof inclosures or switches for polyphase motors up to 15 hp. 110 volts, 30 hp. 220 volts, and 50 hy. 440-550 volts, and for self-starting single-phase motors.— *Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.*

125-Volt Circuit Breaker

PRIMARY circuit breaker for outlet-box mounting provides short-circuit and overload protection for 125-volt a.c. or d.c. circuits, and can also be used as switch control for branch circuits.—*General Electric Co., Schenectady, N. Y.*



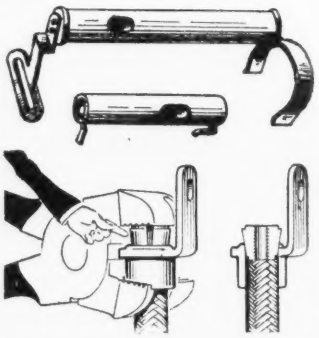


Annunciator Unit

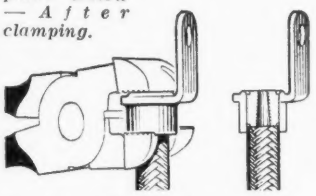
ASSEMBLED in steel cabinet, self-contained or designed to fit into existing gage or control board. Operate on either continuous or momentary alarm contacts, with manual, automatic or remote lamp-reset features. Audible alarms, holding-lamps, and operation counters. — *Kellogg Switchboard & Supply Co., 106 West Adams St., Chicago, Ill.*

Blown-Fuse Indicators

TYPE *B* indicators for ferrule or knife-blade, single- and double-throw switches on 110- to 600-volt circuits up to 600 amp., reddish glow when fuse blows. Not injured by short-circuit.— *F. C. LaMar Indicating Fuse Corp., Chrysler Bldg., New York, N. Y.*



Above—Terminal in place. Below — After clamping.



Conductor Terminal

"WEDGE-ON" conductor terminal is installed by exerting heavy mechanical pressure on wire by forcing tapered wedge into barrel with specially constructed tool. Wire sizes from No. 22 to No. 4. Tool given with orders for 200 "Wedge-ons."—*Thomas & Betts Co., Elizabeth, N. J.*

Solenoid Switch

Two new switches of 50- and 100-amp. ratings added to line of solenoid-operated starting switches. The new switches will handle polyphase motors up to 15 hp. and 110 volts, 30 hp. 220 volts. and 50 hp. 440 to 550 volts. Two new relays give protection against overload.—*Allen-Bradley Co., 1311 South First St., Milwaukee, Wis.*

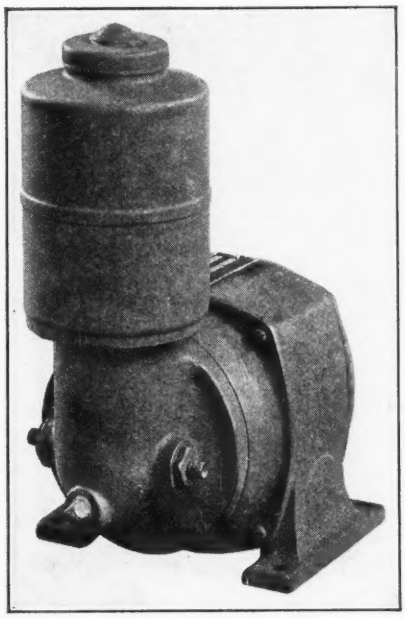
Sealed Capacitors

HALF SIZE, one-third weight of conventional oil-filled units, these hermetically sealed power capacitors impregnated with fireproof "Inerteen." Any size capacitors available from 5 kva. and 230 volts up to 1,200 at 6,900 volts.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

OIL FILTERS, PURIFIERS, LUBRICATORS, LUBRICANTS

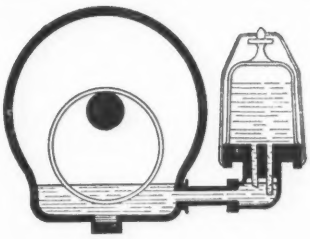
Lubrication System

FULLY-INCLOSED pumping unit for Type "C" system contains only two moving parts. Adjustable timer governs delivery of lubricants through single line to several points. — *Farvall Corp., Cleveland, Ohio.*



Lubricant Barrel Pump

HIGH-PRESSURE, air-operated barrel pump for converting 100-lb. lubricant containers into power guns. Low-pressure pump continuous flow. Thence lubricant is delivered at rate of 18 oz. of regular lubricant per min., or 6½ oz. of extremely fibrous and heavy lubricants.— *Stewart - Warner Corp., Alemite Division, 1826 Diversey Parkway, Chicago, Ill.*

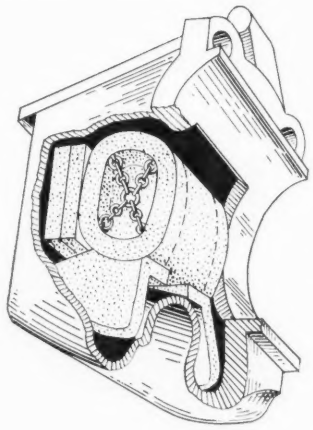


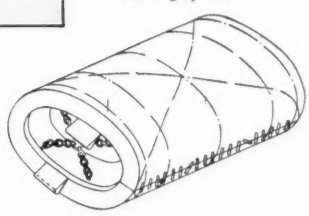
Automatic Oiler

NO MOVING parts. Visible oil supply. "Vis-O-Matic" constant oil-level control. Will not flood bearings nor soak motor windings. — *Somerset Electric Co., Trenton Ave. & Somerset St., Phila., Pa.*

Color Oil Tester

TAG-MACBETH A.S.T.M. Daylight Lamp for color determination gives illumination more closely approximating ideal daylight conditions for color tests than previous lamps. Suitable for use with TAG Saybolt Chromometer, A.S.T.M. Serial D156-34T; TAG Union Calorimeter, A.S.T.M. Serial D155-34T and D218-34T; also TAG Robinson Calorimeter.—*C. J. Tagilabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.*



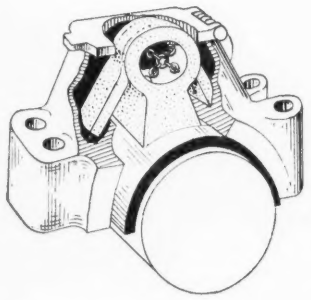


Journal Lubricator

"STAPAX" in standard sizes for journals and custom-made for special sizes. Of fine-quality felt. —*Lubrication Products Co., 1531 W. 25th St., Cleveland, Ohio.*

Oil Cloud Pour-Test Apparatus

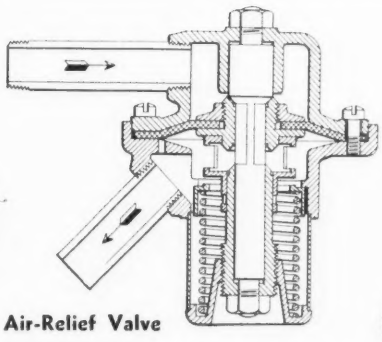
FOUR-COMPARTMENT "cold-test" apparatus meets latest A.S.T.M. cloud pour-test specifications (Serial D-97-34) for lubricating oil, which require at least three, preferably four, baths maintained at 30 to 35, 0 to 5, —30 to —25, —60 to —55. Compartments are copper lined and insulated with 2-in. cork on sides and bottom.—*C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.*



Journal Lubricator

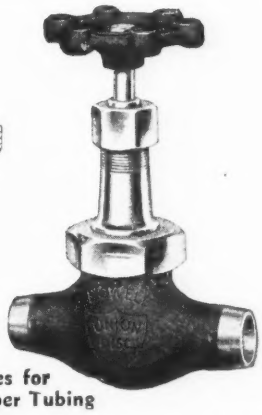
FOR lubricating axlecap and back-shaft bearings, special sizes and shapes of "Stapax" resinous material are available. Oil is drawn up by capillary action from trough in bottom of housing, to bearing surfaces on shaft. — *Lubrication Products Co., 1400 W. 25th St., Cleveland, Ohio.*

PIPING, VALVES AND FITTINGS



Air-Relief Valve

DOUBLE-SEATED, ⅛-in. air-relief valve has one seat to prevent air inflow and one to prevent water discharge. Valve attached to flexible diaphragm and slides on valve stem. Air escapes through passages in stem. Pressure to force air through valve is not sufficient to compress spring, but water will, forcing valve over. Slightest vacuum allows valve to snap back.— *Barrett, Haentjen & Co., Hazelton, Pa.*

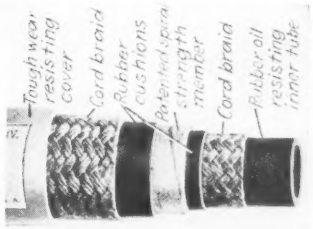


Valves for Copper Tubing

BRONZE valves connected by feeding wire solder through feed hole after pipe has been assembled, and heating with blowtorch. No previous tinning necessary. ¼ to 3-in. sizes, blow, rising and non-rising stem gate valve, and check valve.—*William Powell Co., 2525 Spring Grove Ave., Cincinnati, Ohio.*

Compensated Air Hose

Two strength members, braided cord for longitudinal stresses, and spiralled strength member for expansion and lateral stresses, both welded in rubber. —*Manhattan Rubber Mfg. Division, Raybestos-Manhattan, Inc., Passaic, N. J.*

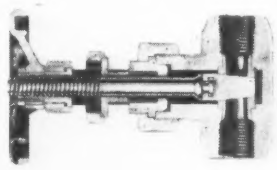


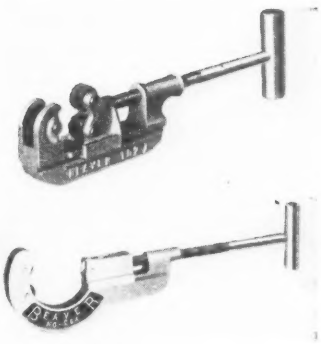
Pipe Wrench

REMOVABLE lower jaw of hardened steel. Drop-forged steel with housing forged integral with handle. "Parkerized" rust-proof finish and cadmium-plated nut. — *Walworth Co., 60 East 42nd St., New York, N. Y.*

Gate Valve

MACHINED from steel bar. List 960 is made in sizes from ¼ to 2 in. for up to 600 lb. pressure at 800 deg. F. Sizes ¼ in. to 1 in. for cold working pressures of 2,500 lb. Larger sizes for 1,500 lb. Renewable stainless-steel stem, plug seat rings. Alloys for corrosives. — *Chapman Valve Mfg. Co., Indian Orchard, Mass.*



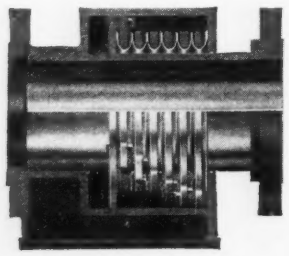


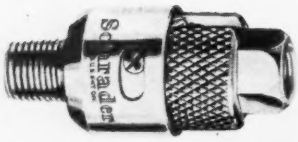
Pipe Cutters

No. 102 Beaver obtainable in either 1- or 3-wheel designs, and for cutting ⅛ to 2-in. pipes. No. 204 is in 3-wheel type only, for cutting 2½-in. to 4-in. pipe. —*Beaver Pipe Tools, Inc., Warren, Ohio.*

Expansion Joint

EXPANSION joint element formed of series of "U-Rings" of stainless steel welded together without transverse seams. One end welded to wrought-steel body of joint and at opposite end to a plate in turn welded to sleeve. Wrought-steel body encloses expansion element. Pressures to 400 lb., temperatures to 800 deg., with flanged or beveled ends for welding. — *American District Steam Co., North Tonawanda, N. Y.*



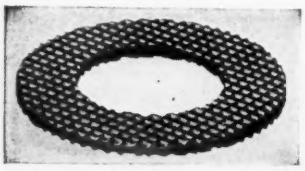


Airline Couplers

FOR attaching and disconnecting airline equipment, these cadmium-plated steel couplers contain a tripping deflator and replaceable rubber washer. Check unit contains automatic shutoff parts.—*A. Schrader's Son, 470 Vanderbilt Ave., Brooklyn, N. Y.*

Gasket

MULTISEAL metallic or semi-metallic gasket to withstand pressure, temperature change and vibration, to produce perfect tightness with only 30% as much contact surface as on plain flat metal gasket, thus will reduce bolt pressure.—*Goetze Gasket & Packing Co., New Brunswick, N. J.*

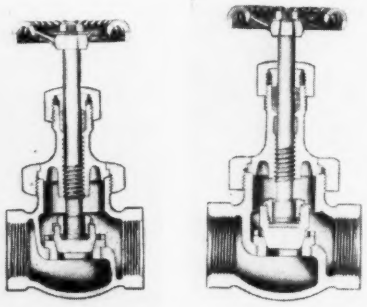


Tubing Cutter

"RIG-D" tubing combines light weight and strength. Made for ⅜ to 1-in. tubing, and weighs but 6½ oz. Is 5¾ in. long when set for ¼-in. tubing.—*Ridge Tool Co., Elyria, Ohio.*

Valves

TWO globe valves for general industrial use, No. 14-P brass valve for 150-lb. steam pressure has plug disk and seat and No. 251-P malleable-iron valve for 250 lb. steam at 550 deg. F. for high-pressure water, oil, air or gas. Disk swivels on stem in former.—*Crane Co., 836 So. Michigan Ave., Chicago, Ill.*

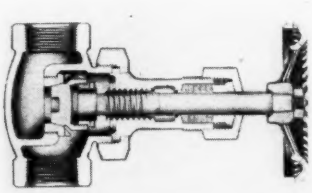


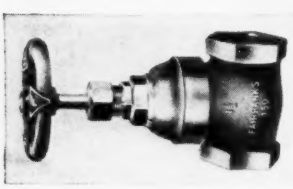
Stain'ess-Clad Welding Ells

FORMED from a ply plate having thin inner or outer (as desired) surface of 18-8 stainless steel on carbon-steel foundation. Also stainless-clad pipe.—*Midwest Piping & Supply Co., Inc., 1420 S. Second St., St. Louis, Mo.*

Globe Valve

A. A. R. globe and angle valves in sizes from ¼ to 2 in. with plug-type disk and seat or ball to flat disk and seat for 300-lb. pressure.—*Crane Co., 836 So. Michigan Ave., Chicago, Ill.*



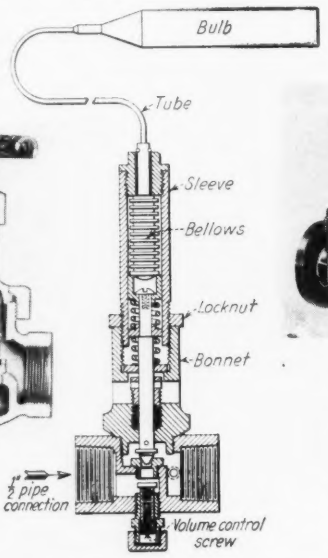


Renewable Gate Valves

SEATS can be renewed by one man in 5 min. without removing body from line. All parts interchangeable. Several types.—*Fairbanks Co., 393 Lafayette St., New York, N. Y.*

Temperature-Controlled Steam Valve

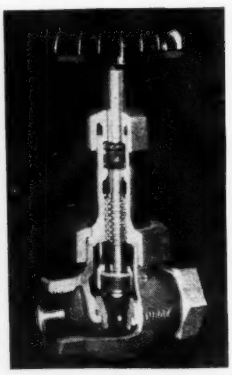
AUTOMATIC temperature - controlled steam valve for vessels in which water or other liquids is



heated by means of steam coil, is of throttling type with thermostat of bulb and bellows design. Made in ½-in. size, this control is usually installed on outlet end of heating coil so that valve handles condensate. Adjusting screw on bottom of valve is regulated to throttle flow to suit volume of condensate. Thermostat bulb clamped to outside of tank or inserted in bulb casing or sleeve attached to tank wall projecting into water space. Adjusting sleeve surrounding bellows end of thermostat to give higher or lower shut-off point. — *Yarnall-Waring Co., Chestnut Hill, Philadelphia, Pa.*

Bonnet Globe Valve

STAINLESS-STEEL valve disk and seat rings, with surfaces hardened to 500 Brinell. Disk attached to stem to insure correct seating and facilitate regrinding. Easy repacking while valve is in service. For steam pressures to 300 lb. Both globe and angle patterns.—*Hancock Valve Co., 75 Elias St., Bridgeport, Conn.*

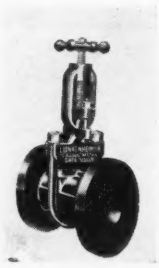


Improved Fire Hose

"WHITE ANCHOR" bias-laid fire hose remains straight when pressure is applied. New method of laying fabric in wrapped hose to eliminate twist under pressure.—*B. F. Goodrich Co., Akron, Ohio.*

Metal Gate Valves For Corrosive Service

"CAUSAL" austenitic ferrous alloy is used in gate valves in screwed and flanged patterns, also in indicator cocks with diamond-shaped port.—*Lunkenheimer Co., Cincinnati.*



Colored Valve Wheel

MOLDED plastic materials designate valves for steam, water, air or any other fluids and gases by five colors: blue, red, black, green and gray; unmarked or with five standard markings in relief. Special colors or markings if required. Wheels strong, cool, easy to grasp, permanent in color. — *Jenkins Bros., 80* White St., New York, N. Y.

Flow-Regulating Valve

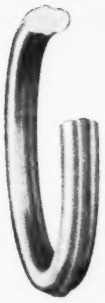
"FLOWCONTROL" wave has special slotted teeth so that flow through valve is always directly proportional to number of turns of handwheel. With micrometer adjustment, valve can be regulated to within one-tenth turn. For steam, oil, water or gas; bronze body, for pressures to 300 lb. in globe (Type 4515) or angle (Type 4535) types. Sizes ⅜ to 2-in.—*Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc., Bridgeport, Conn.*

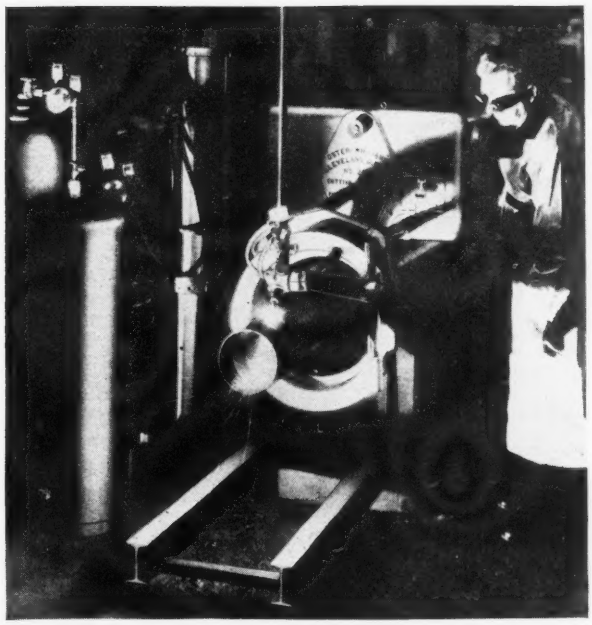
Heavy Tile Conduit

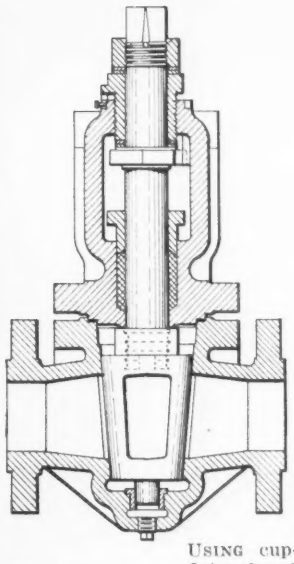
SUPER-STRENGTH tile conduit for underground steam lines may be used under heavy traffic, except railway. Extra heavy walls with special reinforcing. 2-ft. lengths for all diameters, except 26-in., which is 2½ ft. in length. Special base drain, "Loc-Lip" side joint, external pipe supports, and interlocking construction.—*Ric-WiL Co., Cleveland, Ohio.*

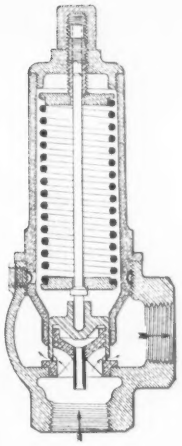
Canvas Sizing

"CE-CO Fibre Laying Size" causes canvas fibers to lie down and not protrude through finish coat of enamel or paint. Also "Ce-Co Pipe Covering Size-Filler" gives waterproof magnesia seal on canvas wrappings. — *Cheesman-Elliot Co., 639 Kent Ave., Brooklyn, N. Y.*









Relief Valve

USING cup-shaped in place of flat valve disk. Pressure transmitted to space within cups is confined and made uniformly effective over entire inner head of cup disk, regardless of valve opening. Open-end pitot tube facing upstream compensates for loss of pressure.—*Klipfel Mfg. Co., 2641 W. Harrison St., Chicago, Ill.*

Lift-Type Valves

PLUG lifted from seat a few thousandths to break friction on surfaces in cast-steel valves in sizes from 1½ to 12 in. One-quarter turn to open or close. Straight-way, 3-way and 4-way types for pressures up to 1,500 lb.—*Homestead Valve Mfg. Co., Coraopolis, Pa.*

Clip-Type Gate Valve

ROUND bonnet permits use of male-and-female joint with asbestos gasket. Full U-bolt holds bonnet joint tight. Full-thickness I-beam cast wedge. Horseshoe connection assembles spindle and wedge. Valves all-iron or bronze mounted. — *Reading Pratt & Cady, Inc., Bridgeport, Conn.*

Forged Iron Ring Gasket

(Cut at top of page)

"GRUV-SEAL" are designed especially for high-pressure and high-temperature lines, where ready disassembly is required. Drop-forged and pressed in a coin die. Sizes from 2½ to 14¾ in. of Armco iron for high temperatures and pressures and of special acid-resisting metals for special-service. — *Steel Improvement & Forge Co., 960 Addison Road, Cleveland, Ohio.*

Through-Flow Valves

ADAPTED for steam, air, gas and any fluid service lines to insure continuous flow. Seals tight open or tight shut, thus protecting seat rings against wear. Valve unseats axially before plug valve is rotated; clearance readily adjustable from outside for any clearance 0.01 to 0.06 in. No lubrication required. Furnished in 2-way, 3-way and 4-way designs of bronze, iron, steel and other metals, screwed or flanged ends in sizes ¼ in. and larger for all service pressures. Also furnished to operate with handwheel or for automatic operation in larger sizes.—*Golden-Anderson Valve Specialty Co., Automatic Thru-Flow Valve Co. Div., Fulton Bldg., Pittsburgh.*

Steel Pipe Wrench

TRIMO drop-forged wrench has replaceable upper and lower teeth. Chrome - molybdenum, manganese and nickel steels incorporated, each to suit its work. Handles extra long, better weight distribution, special spiral spring for longer wear and quick bite and release.—*Trimont Mfg. Co., Roxbury (Boston), Mass.*

Pipe-Cutting Machine

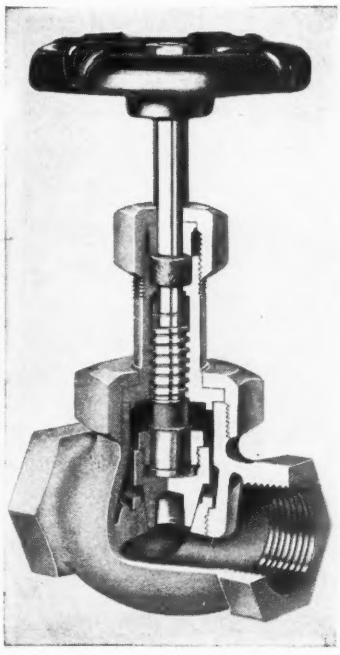
MACHINE No. 212 cuts pipe from 2½ to 12 in. diam. in preparation for welding. Aluminum generating case on rotating column can be swung in any direction.—*Oster-Williams, 2057 East 61st Place, Cleveland, Ohio.*

Reducing Valve

VALVE streamlined. Flow through in a straight line. A jet extends into outlet chamber. When demand increases, accelerated flow through this jet produces an aspirating effect that lowers pressure in control chamber, thus opens valve.—*A. W. Cash Co., Decatur, Ill.*

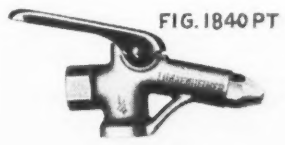
Plug-Type Valve

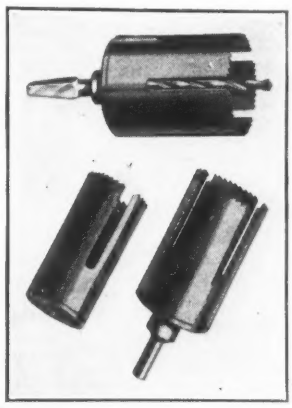
FOR service under excessive wire-drawing or destructive action on valve seat or disk. Long seating surface between plug and seat can be readily reground or renewed. Seat ring screwed into diaphragm, providing easy renewal. — *Fairbanks Co., 393 Lafayette St., New York, N. Y.*

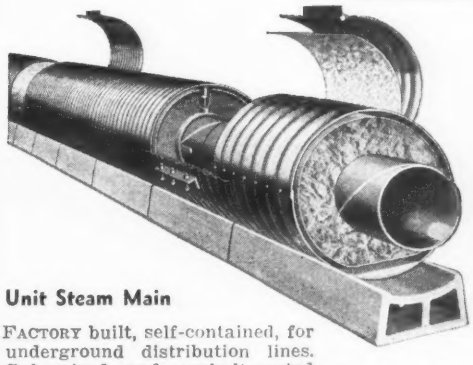


Air Nozzles

BRONZE nozzles with renewable non-metallic disks, one with integral hose end (Fig. 1840-PT), one with female pipe end (Fig. 1841-PT), either pattern with pointed, flat or extension tip. Lower brace provides opening for hanging nozzle on rail or hook. — *Lunkenheimer Co., Cincinnati, Ohio.*





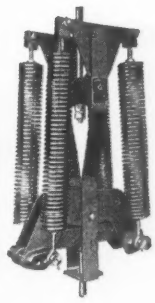


Unit Steam Main

FACTORY built, self-contained, for underground distribution lines. Galvanized and asphalt-coated "Armco" iron, with waterproof asbestos insulation. Pipes, supports, liner, conduit sections, and all accessories included.—*Ric-WiL Co., 1562 Union Trust Bldg., Cleveland, Ohio.*

Pipe-Hole Saws

FOR cutting holes for pipes through wooden floors, ceilings and partitions. Cutters or saws are of sufficient length to go through three thicknesses of flooring. In five sizes from ¾ in. to 2 in. Used either in bit brace or in electric drill.—*R. M. Starbuck & Sons, Hartford, Conn.*



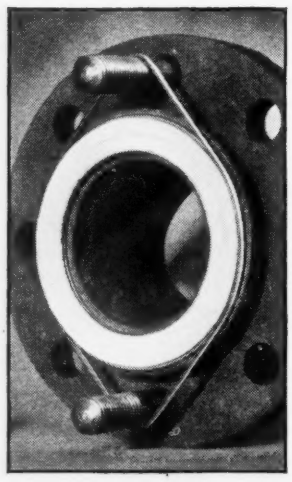
Constant-Support Pipe Hangers

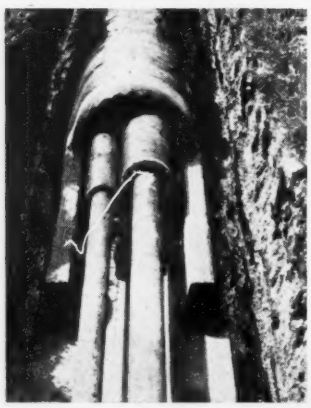
"GENSPRING" hangers permit movement in any direction while affording constant support. No

back thrust. Three frame sizes: No. 1, light-duty, No. 2, medium-duty, and No. 3, heavy-duty.—*Grinnell Co., Providence, R. I.*

Pipe-Flange Gasket

"FLEXITALLIC" Style D gasket has centering guide conforming to A.S.M.E. standards. Up to 600 lb., metal is cold-rolled steel. Above 600 lb., stainless steel or Monel used. Other types for special cases. ⅛ in. thick.—*Flexitallic Gasket Co., 8th & Bailey Sts., Camden, N. J.*





Steam Conduit

"THERM-O-TILE" can be varied to meet any conditions. Base sections vary in height from 6 to 12 in., in increments of 2 in., while top tile envelopes vary from 9 in. to 24 in. diameter in increments of 3 in. Any base may be used with any envelope.—*H. W. Porter & Co., Inc., 825 Frelinghuysen Ave., Newark, N. J.*

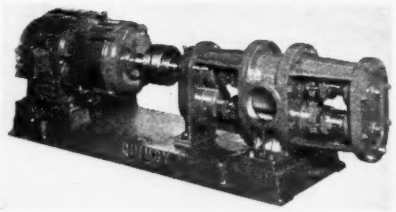
Single-Seat Valves

STEEL throughout for 600-lb. pressure, standard. Any reverse flow through closes disk. Dashpot prevents shock closing. As valves are bottle-tight, they can also be used to effect shut-off in place of motor-driven or hand-operated gate valves. — *Davis Regulator Co., 540 Washtenaw Ave., Chicago, Ill.*

Pipe Coupling

STYLE 65 pipe ends (threaded also) are inserted into coupling (which comes assembled) and then two threaded octagonal nuts are tightened on it. Black or galvanized in standard steel-pipe sizes from ⅜ to 2-in. I. D.—*S. R. Dresser Mfg. Co., Bradford, Pa.*

PUMPS FOR POWER PLANT AND INDUSTRIAL USES



Rotary Pump

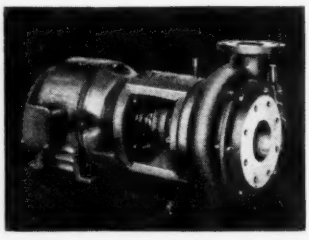
FOR handling liquids with no lubricating qualities, "Rotex" has external gears and bearings. Discharge pressures up to 200 lb. per sq.in., with viscous products, and up to 50 lb. per sq.in. for non-viscous fluids. Pumping element consists of two oval rotors mounted on parallel shafts set with long center lines 90 deg. apart and revolving without metallic contact. Angularity between rotor centers controlled by timing gears mounted on chain shaft, which also transmits power from driver to companion shaft. — *Quimby Pump Co., 364 Thomas St., Newark, N. J.*

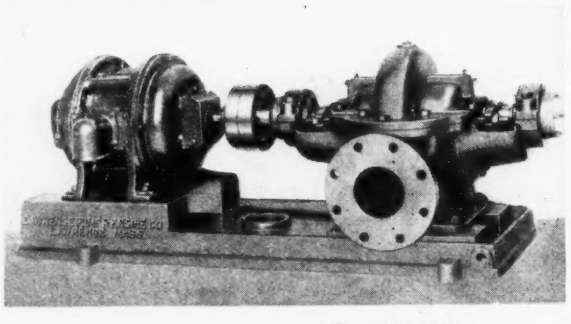
Deepwell Turbine Pump

12-IN. No. 2K replaces former "A" type. 80% efficiency from 600 to 1,100 g.p.m., at 1,750 r.p.m.; performs correspondingly at other speeds. Other sizes include 10- and 14-in. sizes.—*Byron Jackson Co., Berkeley, Calif.*

Chemical Pumps

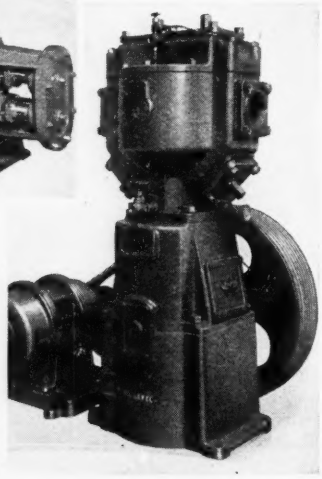
PUMP uses closed impellers and pump ends made of special alloys such as nickel, stainless steel, Illium, acid bronze, etc. Independent of bolting bracket. Revolving shell to provide several discharge positions.—*Buffalo Pumps, Inc., Buffalo, N. Y.*





Centrifugal Pump

"BLACK ARROW" single-stage centrifugal pumps in sizes from 2 to 14 in. for capacities from 30 to 10,000 g.p.m. and for heads up to 300 ft.—*Lawrence Pump & Engine Co., P. O. Box 70, Lawrence, Mass.*



High-Vacuum Pump

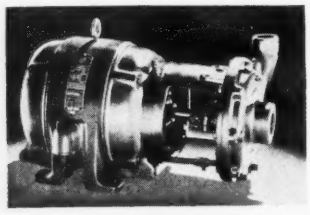
DOUBLE-ACTING single vertical pump in either one or two stages, depending upon degree of vacuum. Air-tight, dust-proof case. Lubrication force-feed. Feather valves.—*Worthington Pump & Machinery Corp., Harrison, N. J.*

Valve with Malikite Disk

DISK is "Malikite," canvas impregnated with a Bakelite compound.—*J. C. Edgecumbe Co., 295 Pearl St., New York.*

Motorpump Unit

CONSISTS of a high-efficiency centrifugal side-suction pump with closed bronze impeller mounted directly on shaft of ball-bearing splash-proof motor. Shaft runs in ball bearings. 10 to 250 g.p.m., heads up to 190 ft., with motors rated ¾ to 10 hp. — *Fairbanks, Morse & Co., 900 S. Wabash Ave., Chicago.*



Centrifugal Pumps

HORIZONTAL-SHAFT, split-casing, double-suction, bronze-fitted, multi-stage pumps for heads 400 to 1,600 ft. and capacities to 400 g.p.m. Double-suction runners. Each stage of casing has spiral volute. — *Allis-Chalmers Mfg. Co., Milwaukee, Wisc.*

High-Lift Pump

"HYDROPRESS" centrifugal pump will build up pressures to 2,800 lb., in capacities from 10 to 250 g.p.m. Four standard sizes, 8, 10, 12 and 15 in. Stages from 4 to 54.—*Byron Jackson Co., Dept. 57, Berkeley, Calif.*

Volatile Liquid Pump

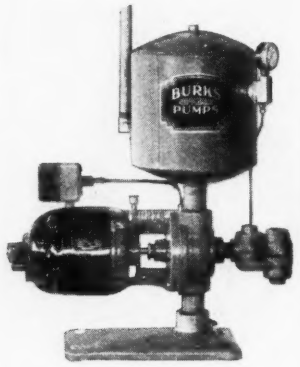
TYPE "T" turbine pump with priming chamber including integral by-pass and relief valve. Sizes from 20 to 350 g.p.m. Quiet and vibrationless, low friction. — *Roots-Connersville Blower Corp., Connersville, Ind.*

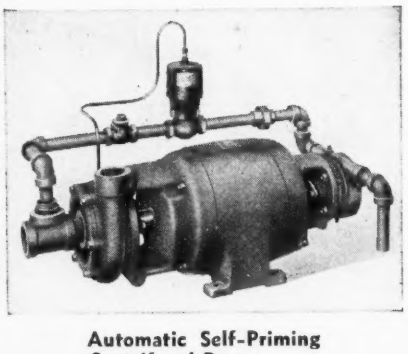
Ungraphited Packing

SPECIALLY for packing pumps where graphite must not enter finished product, "Klero" has colorless, odorless and tasteless lubricant containing no graphite. Working sample upon request.—*Greene, Tweed & Co., 109 Duane St., New York, N. Y.*

Water System

SERIES 8780 complete water system in four sizes of 200 or 300 g.p.m., using 1/6- and ½-hp. motors, respectively, and operating on 60-cycle or lower frequencies a.c., or 32- or 110-volt d.c. Total head 50 lb. per sq.in., or 115 ft. Self-priming. Continuous discharge. Direct drive. Automatic air-volume control. Automatic overload motor disconnect.—*Decatur Pump Co., Decatur, Ill.*





Automatic Self-Priming Centrifugal Pump

THIS Monobloc has no floats, hand-operated valves or recirculation. Utilizes "Hytor," a positive primer on same shaft with motor and pump. Unit compact and neat with splash-proof streamlined motor on symmetri-

cal mounting. No tanks or float chambers. Single or polyphase 50- or 60-cycle a.c. and d.c. operation. — *Worthington Pump & Machinery Corp., Harrison, N. J.*

Centrifugal Pump

OPEN-IMPELLER "non-clogging" pumps for handling solid materials in suspension, gritty liquids, etc. "Monobloc" construction. Available in all-iron, all-bronze, bronze-fitted, and such materials as stainless steel, Everdur and Monel metal. Ratings from 10 to 250 g.p.m. against heads of 10 to 100 ft., ½ to 7½ hp., 1,500 to 3,600 r.p.m., a.c., or d.c., 50- and 60-cycle single- or polyphase.—*Worthington Pump & Machinery Corp., Worthington Ave., Harrison, N. J.*

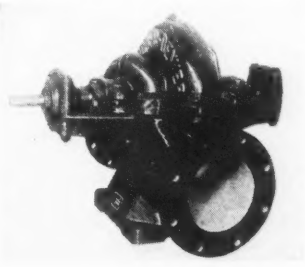
Chemical Pump

PUMPS exact quantities of water-treating chemicals into water supplied at intervals, dependent upon rate of water flow. Also adaptable to any type of liquid or semi-liquid. Rugged construction, smooth, steady action. Stroke adjustment from 0 to 3 in. Plunger adjustable for complete cylinder displacement, eliminating air pocketing. Plungers and cylinder interchangeable from ½- to 3-in. diameter. ¼-in. cylinder operates safely up to 1,800 lb. pressure; 1 in. to 1,000 lb. Pressure lubrication.—*Dearborn Chemical Co., 310 S. Michigan Ave., Chicago.*

or outside end-packed plunger type liquid end for hot or cold liquids. — *Worthington Pump & Machinery Corp., Harrison, N. J.*

Double-Suction Centrifugal Pump

SINGLE-STAGE split-case units are recommended for general water supply and similar installations.

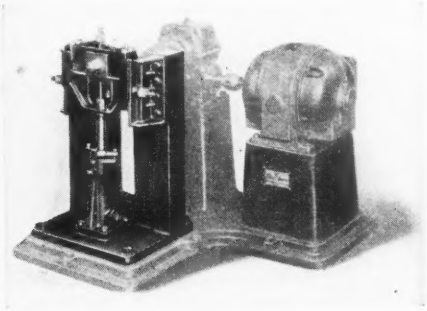


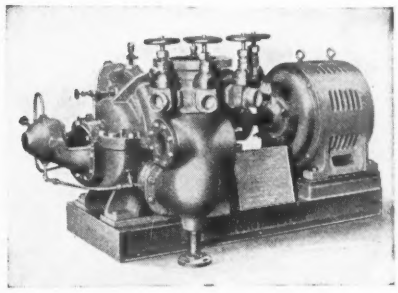
Side-Suction Centrifugal Pump

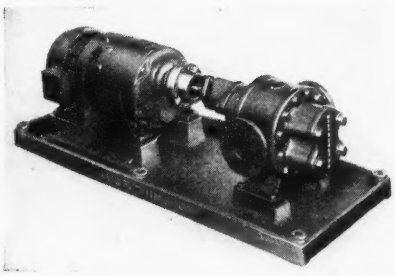
TYPES B (illustrated) and C pumps handle capacities up to 500,000 g.p.d. or 450 g.p.m. at heads to 100 ft. Cast-iron impellers. Heavy-duty ballbearing at pulley end. Grease-lubricated sleeve bearing at impeller end. Water piped to this bearing in case grease supply fails.—*Gardner-Denver Co., Quincy, Ill.*

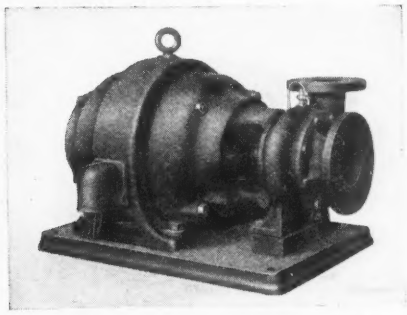
Centrifugal Fire Pump

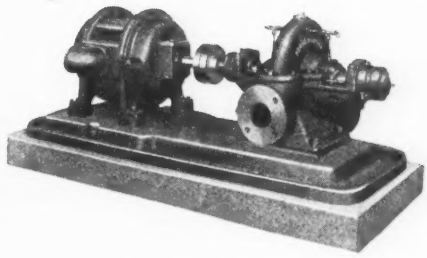
GROUP LG, single-stage, volute type, direct-connected to electric motor, diesel, gas or gasoline engines, or steam turbines. Fully inspected and approved by National Board of Fire Underwriters and Factory Mutual Fire Insurance Co.—*Worthington Pump & Machinery Corp., Harrison, N. J.*











Rotary Pump

FOR pumping clean liquids, including those that solidify when cool. Steam-jacketed pumps for pressures up to 300 lb. per sq.in., temperatures to 650 deg., capacities from 10 to 2,500 g.p.m. Internal sleeve and roller bearings for non-corrosive liquids; external ball bearings for corrosive liquids. — *Worthington Pump & Machinery Corp., Harrison, N. J.*

Two-Stage Centrifugal Pump

MONOBLOC low power requirements and simplicity make it applicable to services requiring small capacity and medium-discharge head. Casing designed for 150-lb. pressure, bolted directly to motor frame. Two enclosed-type impellers cast back-to-back. Overhung weight no

Centrifugal Pumps

Two larger sizes "Monobloc," 3-in. and 4-in., similar in design to smaller (1 to 2½-in.) units. Pump, besides being rigidly mounted on motor frame, is supported by foot on base. Impeller mounted directly on motor shaft. Renewable wearing rings and balance rings. Variety of material combinations. Mounting either horizontal or vertical.—*Worthington Pump & Machinery Corp., Harrison, N. J.*

Inclosed Horizontal-Duplex Pump *(Cut at left)*

SELF-CONTAINED power end supported on foundation through its length. 18-in. stroke, totally-inclosed pump, built for continuous duty. Frames cast enbloc. Main gear and pinion full herringbone. Either packed piston

Any type of drive. Series covers all heads to 300 ft. Shaft sleeve nut outside pump and next to housing. Nut is also used as jack to remove ball bearing, thus requiring no puller. — *Gardner-Denver Co., Quincy, Ill.*

Piston Pumps

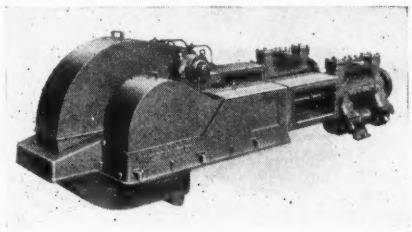
LIQUID and side-pot type with minimum clearance and removable cylinder liners. Interchangeable. Discharge working pressures up to 500 lb. per sq.in. in Wompco metal, and 700 in cast steel. Available as simplex and duplex steam driven, or duplex power pumps driven by steam, gas or diesel engines or electric motors, either direct-connected or through multi-V drive. — *Worthington Pump & Machinery Corp., Harrison, N. J.*

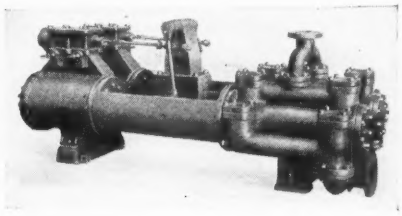
Centrifugal Pumps

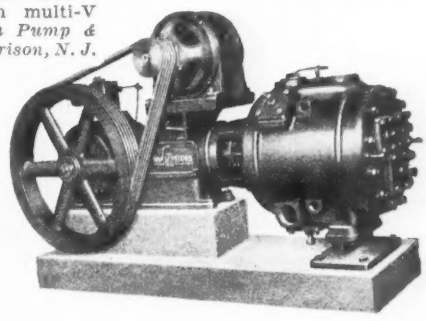
DOUBLE-SUCTION, single-stage, sleeve-bearing pump, Classes SHD, SMD and SLD, has horizontally split casing with both suction and discharge openings in lower half. Bronze double-suction inclosed-type impeller. Renewable casing wearing ring. Pump direct-connected to prime mover by flexible pin-and-rubber buffer coupling on cast-iron baseplate.—*Pennsylvania Pump & Compressor Co., Easton, Pa.*

Vacuum Pumps

SINGLE-STAGE and 2-stage horizontal, roller-bearing type, air-cushioned-valve vacuum pumps, Class 7-AT and 8-AT, for power and steam drives have frame opened over crank end of main bearings. — *Pennsylvania Pump & Compressor Co., Easton, Pa.*



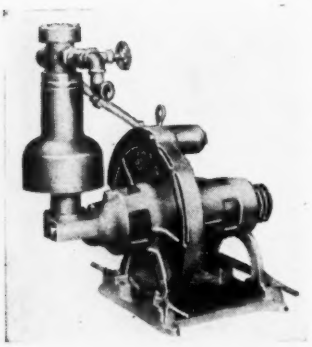




STEAM, OIL AND GAS PRIME MOVERS AND AUXILIARIES

Auxiliary Steam Turbine

TROJAN turbine can be used with generators for services requiring up to 3½ hp. Bearings for high speed. One-piece rotor. Complete with baseplate upon which can be direct-connected any standard generator or pump. Wt. complete, 275 lb.—*California Bettis Co., 1900 East 65th St., Los Angeles, Calif.*

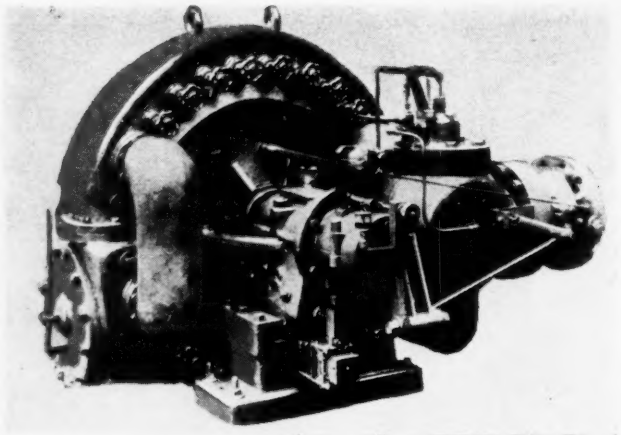


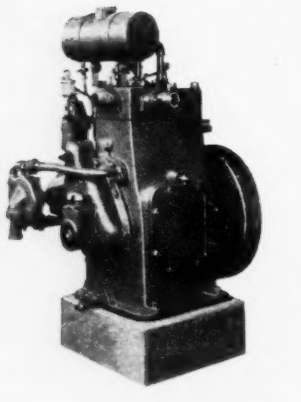
Diesel Engines

TYPE GA, 2-cycle, horizontal diesel rated at 25 to 45 hp. with single cylinder and 85 to 110-hp. with twin cylinders, has Timken bearings, die-forged crankshafts, drop-forged connecting rods, and automatic lubrication. Type GN, 4-cycle, vertical, gas or diesel (latter with atmospheric-relief fuel-injection system). Built in 3, 4, 6 and 8 cylinders, rated at 50-60 hp. per cylinder as gas engine and 45-55 as diesel.—*Cooper-Bessemer Corp., Mt. Vernon, Ohio.*

Center-Supported Turbine

TYPE BDE permits casing to expand vertically, longitudinally or laterally without restriction. Two heavy pedestals, one at coupling end cast in one unit with bearing housing, and bolting flange to support casing closely at horizontal center line; other at governor end cast in two units.—*D. E. Whiton Machine Co., New London, Conn.*





Diesel and Gas-Engine Starter

SINGLE-STAGE air compressor for starting gas and diesel engines said to be capable of filling 6 cu.ft. tank to 200 lb. pressure in 5 min., or 250 lb. in 9½ min. Known as GX3A; uses either gas or gasoline. Ford pistons, piston rings, connecting rods, connecting-rod bearings, engine valves, and many smaller parts are used. — *Cooper-Bessemer Corp., Mt. Vernon, Ohio.*

Temperature Control for Internal-Combustion Engines

FORMS nucleus for automatic engine protection. Control sealed in glass tube, inclosing an inert gas to avoid pitting or oxidation of contact points. Mounted in a metal tube provided with standard pipe threads and suitable junction box for electrical connections. — *Edison Electrical Controls Division, Thomas A. Edison, Inc., West Orange, N. J.*

Diesel Fuel Filter

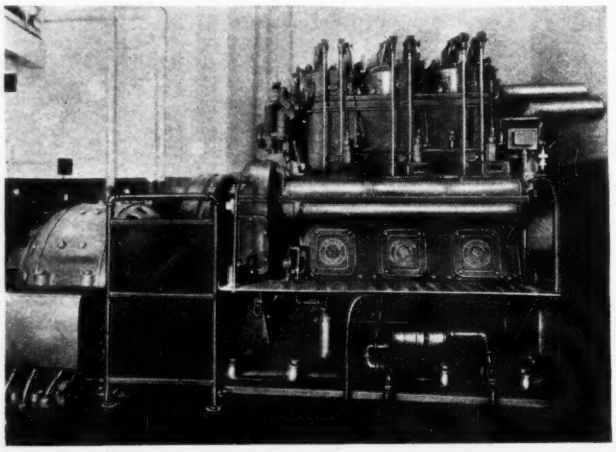
D-23JWM-1, "Purolator" made up of two units; knife-cleaning metal element; woolen fabric element with metal element inside. Tapped for ¼-in. iron pipe, capacity 4.45 g.p.m.—*Motor Improvements, Inc., 365 Frelinghuysen Ave., Newark, N. J.*

Scale-Solvent for Diesel Exhaust-Header Jackets

"ARTJEL" is hydrochloric acid combined with organic inhibitors in such a combination that they dissolve scale while suppressing solution or corrosive attack upon metal walls of header. Special material.—*Artic Chemical & Combustion Engrg. Corp., 209-211 King St., Brooklyn, N. Y.*

Diesel Engines

Two classifications; general service and direct-connected for electric service. 4-cycle, may be converted to gas engine if desired. Welded steel, water-jacketed, exhaust manifolds. Removable air-intake manifold fitted with flange for silencer or pipe extension. Poppet-type air-starter valve with removable cage. Individual fuel pumps for each cylinder. Sizes from 100 to 800 hp.—*Chicago Pneumatic Tool Co., 6 East 44th St., New York, N. Y.*

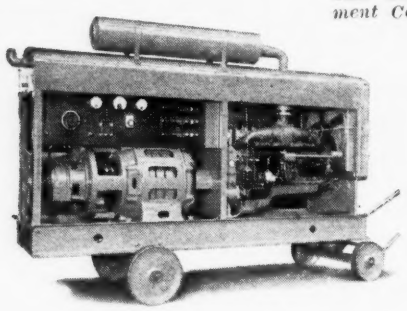


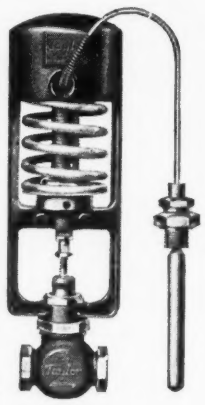
Portable Power Unit

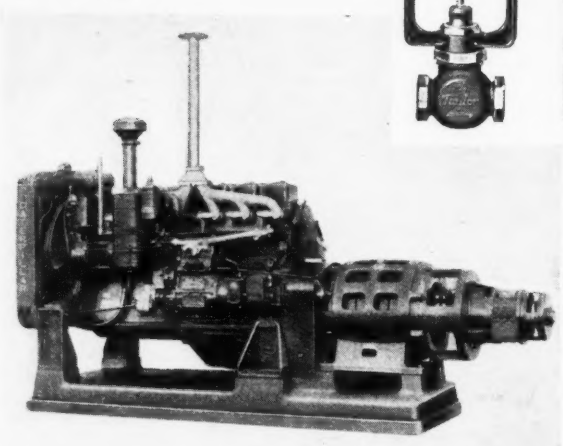
GAS-POWERED, these units have rated capacity of 35 kw. for 240-volt, 3-phase, 60-cycle current.—*Harnischfeger Corp., Milwaukee, Wis.*

Diesel-Water Temperature Control

CONTROLLER for diesel cooling-water temperature requires no auxiliary power and has temperature adjustment mounted on ball bearings.—*Taylor Instrument Cos., Rochester, N. Y.*







Diesel-Generator Set

"HARNISCHFEGER - CATERPILLAR" sets in capacities from 35 to 60 kw. for a.c. or d.c. Illustrated is 50-kw. alternator with mounted exciter. Standard unit includes engine with all auxiliaries coupling flywheel and coupling guard and generator on unit base. Built cooperatively by Harnischfeger Corp., Milwaukee, and—*Caterpillar Tractor Co., Peoria, Ill.*

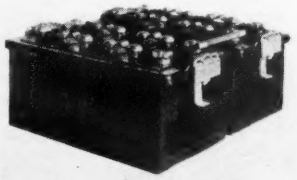
6-Cyl. 5¾x6½-in. Diesel

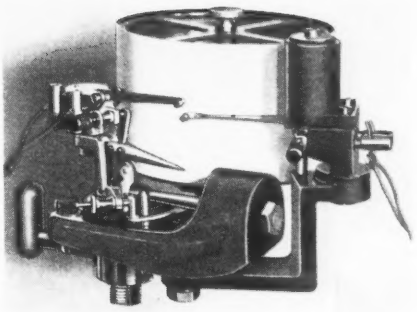
MD SERIES is a 5¾x6½-in. 6-cyl. diesel with economical horsepower ranging from 100 to 160. Has combined fuel pump and nozzle. Injector in center of cylinder head surrounded by four valves. Actuated by two camshafts, one on each side, thus forming balanced drive. Injector pressure into combustion chamber ranges from 2,000 lb. idling to 4,500 lb. at maximum speed. Eliminates all high-pressure fuel lines and pulsations in fuel line. Unit started with gasoline burnt within its own combustion chamber; gives positive start by hand. Conventional 24-volt generator starting motor and battery system also available if desired. Pressure lubricated. One camshaft operates all inlet valves; other operates all exhaust, both operating fuel injectors mounted between. All valves and fuel injectors permanently mounted in cylinder head. Replaceable valve seats in cylinder head. Variety of sizes, 1 to 6 cyl.—*Murphy Diesel Co., Ltd., S. 53rd & W. Burnham Sts., Milwaukee, Wis.*

for outputs up to 90 hp., and 22-in. 3 turbine for output up to 150 hp. Built-in speed reducers if desired.—*Coppus Engineering Corp., Worcester, Mass.*

Diesel Starting Batteries

PARTICULARLY designed for high current up to 1,600 amp. at low temperature for starting diesels with high cranking speed. Extra heavy, flexible, lead-plated copper connectors between cells. Also heavy-duty, hard rubber monobloc containers. Types and sizes for engines from 25 to 600 hp. where required voltage varies from 12 to 115 volts and current from 300 to 1,600 amp. Illustrated is 800 to 1,600-amp. —*Electric Storage Battery Co., Allegheny Ave., Philadelphia.*

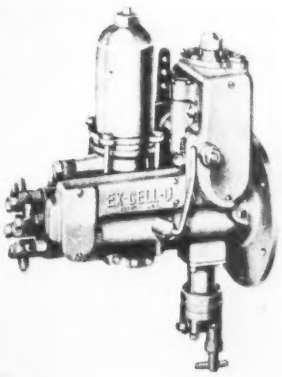


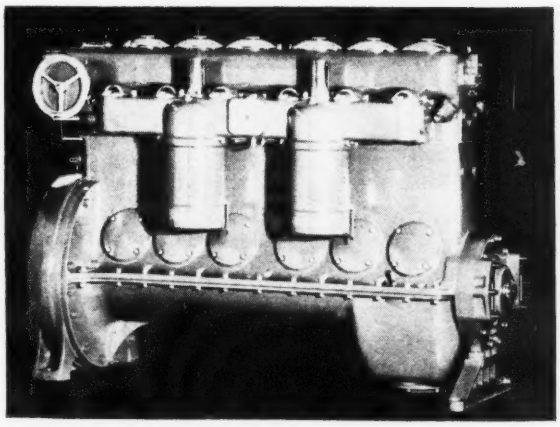


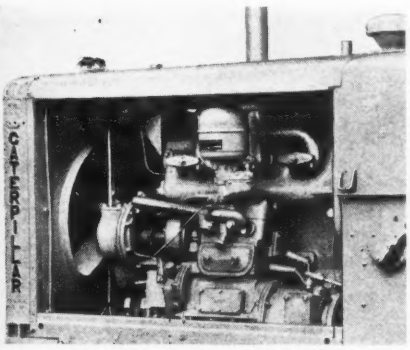
arach Industrial Instrument Co., 7000 Bennett St., Pittsburgh, Pa.

Three 4-Cycle Diesels

CATERPILLAR has redesigned its 75, 50 and 40 power units for greater power, now offering D13000 (125 b.hp. max., 95 b.hp. continuous duty), D8800 (77 b.hp. max., 59 b.hp. C.D.) and D6100 (47 b.hp. max., 37 b.hp. C.D.). All are 4-cycle, gasoline-engine started, 5¾x8 in., 850 r.p.m., with 6, 4 and 3 cylinders respectively. Force-feed lubrication. Improved injection system. Steel channel base. Fourth model will be 4-cyl., 4½x5½ in. 1,400 r.p.m. unit with 2-cyl. opposed-piston horizontal gasoline starting engine at rear. — *Caterpillar Tractor Co., Peoria, Ill.*



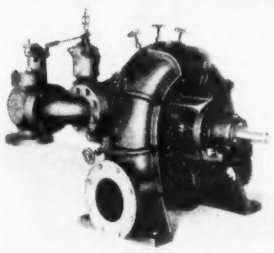




Diesel Fuel-Injection Pump

EX-CELL-O pump, Model A, has governor, filter and fuel pump as standard accessories. Designed for diesels up to 200 hp., or 26 to 260 cu.in. piston displacement. Flange-type mounting (shown) for motive power or production installations, base-type for test purposes. 4- or 6-cyl. engines. Hydraulic unit is *replaceable* precision assembly. Pump is swash-plate design.—*Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich.*

REGULATORS AND CONTROLLERS

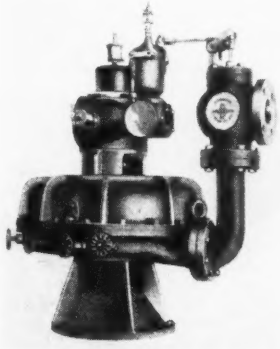


10-Cyl. Radial Diesel Engine

CONTINENTAL 6½ x 7½-in., 2-cycle, 635-hp. @ 1,400 r.p.m., weighs but 3,900 lb. complete with accessories, or about 6 lb. per hp. 71 in. in diameter, 41 in. long over-all and 82 in. over-all with generator. One master piston rod and nine articulated rods. One fuel system handles even numbered cylinders, other odd. Exceptionally smooth operation. Uniflow scavenging. Fuel consumption first engine 0.45 lb. per b.hp., better expected with refinements.—*Continental Motors Corp., Detroit and Muskegon, Mich.*

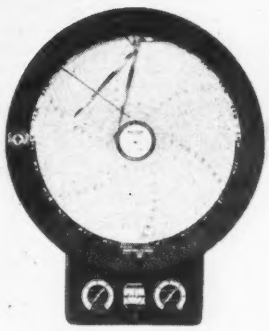
Steam Turbines

TWO units for horizontal and vertical operation extend range from 60 to 150 hp. 22-in. rotor, 2½-in. governor valve turbine



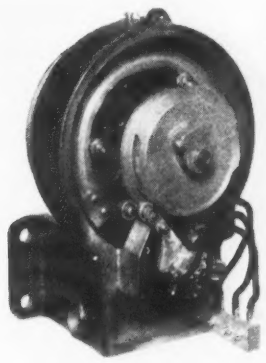
Pressure-Time Indicator for High-Speed Diesels

PRESSURE-TIME drums for all types of Maihak indicators, including high-speed unit. Substitution of cantilever for usual helical spring reduces inertia of moving parts and permits unit to be used at engine speeds to 2,000 r.p.m. Indicator regularly furnished with piston of ½ sq.in. area, and springs calibrated for this piston available from 36 to 1 lb. per sq.in. per 1 in. card height. Chart speeds of 150-450 r.p.m., and adjustment for four intermediate speeds. Uniform drum rotation obtained by built-in. centrifugal governor.—*Bach-Brown Instrument Co., Wayne & Roberts Ave., Philadelphia, Pa.*



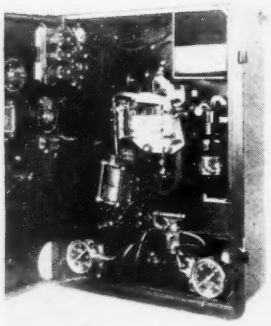
Air-Operated Controllers

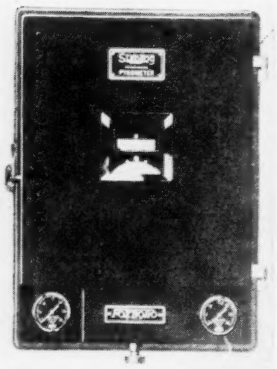
SERIES of recording and indicating, air-operated controllers for temperature, flow, pressure and liquid level. Includes "Air-O-Line," with 1% to 150% throttling range, and automatic reset. Thermometer-type for temperatures between —40 deg. F. and 1,200 deg. F., and potentiometer-type for temperatures between —300 deg. F., and 3,400 deg. F. Also inductance-bridge type and mechanical-type flow and liquid-level controllers combined. Controllers for 30 in. of vacuum to 3,000 lb. per sq.in. pressure.—

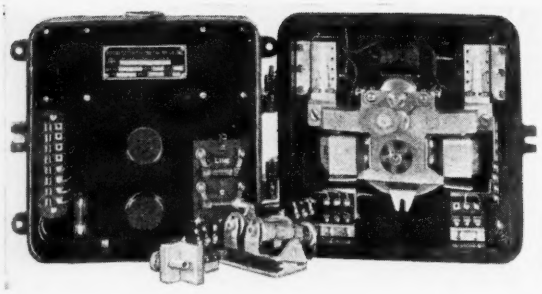


Shifting Control Switch

MEANS of operating increase and decrease contacts of speed control with small arc of total damper movement. Adjustable angular movement of damper between increase and decrease contacts. Full movement of damper through operating range will carry fan-speed changes through maximum range.—*Hagan Corp., Pittsburgh, Pa.*







Automatic Control

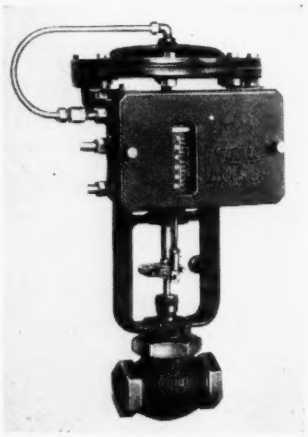
POTENTIOMETER Stabilog combines temperature measurement features of potentiometer system with control advantages of Stabilog system. Will control temperatures up to 2,800 deg., without hunting and over-controlling, and free from manual auxiliary adjustment. Case has double doors, outer gasketed.—*Foxboro Co., Foxboro, Mass.*

Self-Acting Temperature Regulator

LESS than 1-deg. variation in temperature will move valve disk of this unit with proper throttling action from open or closed position. Most of throttle energy is obtained from heat energy of steam in valve body, less than 1% being taken from thermostatic bulb. Packless and balanced - valve construction. Lever-action unit. Action instantaneous. Regulator will withstand over 100 deg. overload; range is 40 deg. Hand-adjusted over entire range of 40 deg. in less than 10 sec.—*Emil T. Johnson Regulator Co., 6435 N. Talman Ave., Chicago, Ill.*

Temperature Regulator

CONSISTS of electric thermostat of a liquid-expansion type with commutator switch carrying six separate contacts. Suitable for 50 to 950 deg., and can be used with valves for steam, water, oil, gas or brine. Thermostat sensitivity and speed of valve travel are adjustable by user. Motive power to operate single-seated valves of any size from ¾ to 16 in.—*Wilbin Instrument Corp., 40 East 34th St., New York, N. Y.*

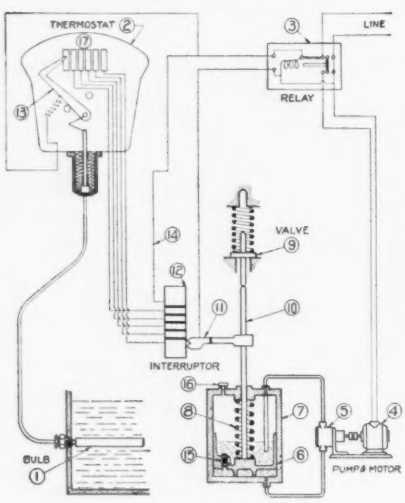


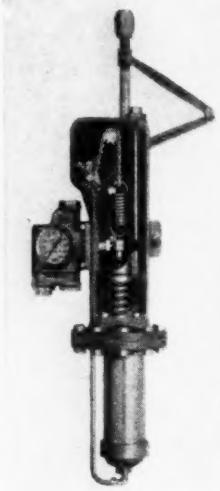
Valve-Control Unit

PRECISION-valve-action unit for processes which have time lags or heat capacities demanding low or medium controller sensitivity provided load changes are negligible or infrequent. "Valve Precisor" mounted on any diaphragm valve and used in conjunction with air-operated controller. — *Taylor Instrument Companies, Rochester, N. Y.*

Controllers

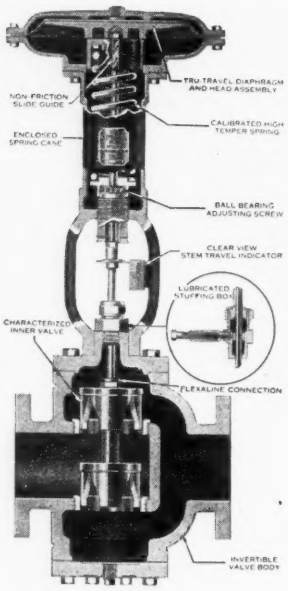
TYPE 100 series controllers comprise actuating member, diaphragm or lever; 4-way control valve which governs flow of water, oil or air to a double-acting power cylinder. Built-in compensator and range adjustment.—*A. W. Cash Co., P. O. Box 135, Decatur, Ill.*





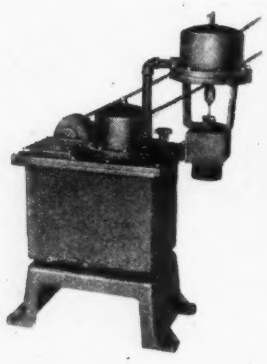
Time Control Unit

SERIES 1274-5-6 time controls repeat one or two operations or processes as often as desired. Will handle a repetitive action or operation requiring different time period or cycle with either same or different time period between successive time cycles. Time cycle and also interval between successive cycles is indefinitely adjustable with accuracy within a split scale division. 110 volts, a.c. or 220 volts, a.c., if ordered. — *Automatic Temperature Control Co., 34 E. Logan St., Philadelphia, Pa.*



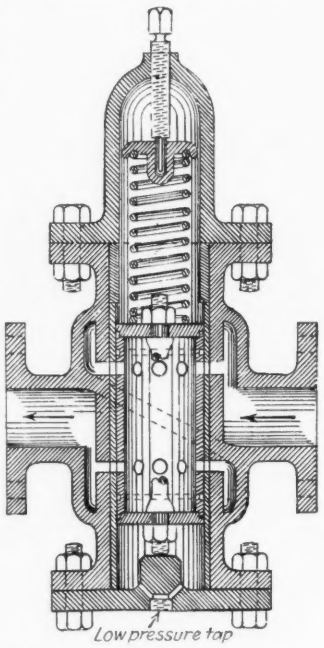
Control Valves

TYPE 57T Tru-Travel diaphragm control valve for pilot operation has special-design head, long-travel diaphragm and non-friction slide guide. Ball-bearing adjusting screw for easy changing of settings. High-tempered calibrated adjusting spring.—*Fisher Governor Co., Marshalltown, Iowa.*



Diaphragm Valves

NEW type, long-range throttling top incorporates arrangement for adjusting spring pressure so that member in contact with spring bottom does not turn when adjusting feed screw is turned, but merely moves up or down.—*C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.*



Pressure Control Valves

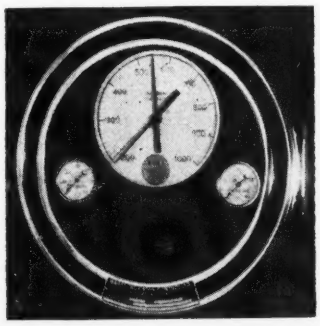
"ROUBELL Balanced - Piston" valves for pressure, speed, flow, load and pilot control, with steam, water, air, gas, oil and chemicals. Three types, interchangeable pressure reducer and constant-pressure pump governor (illustrated), pilot valve control pressure reducer and excess pressure boiler-feed pump governor. Known as Series A, B and C, respectively. Unit illustrated is interchangeable, can be used either for straight pressure reduction or as constant-pressure pump governor. Both screwed and flanged types with semi-steel or steel bodies, in sizes from ¼ to 8 in.—*Crankshaft Machine Co., 320 N. Jackson St., Jackson, Mich.*

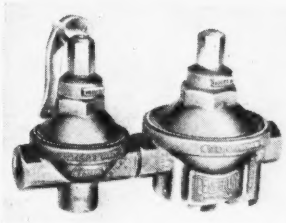
Oil Relay Governor

TO CONTROL speed of steam-driven auxiliaries, this completely-inclosed governor uses oil pump driven at speed proportional to auxiliary's speed delivering oil to line with variable leak port. Oil pressure depends on pump speed and adjustment of leak port and controls steam valve. Stable regulation over speed range of 10 to 1.—*Hagan Corp., Pittsburgh, Pa.*

Air-Operated Indicator-Controller

FOR pressure and temperature control applications not requiring record, this indicator controller operates diaphragm motor-valve or air-operated control drive, 13-in. diam. round casing on panel, wall or column. Has indicating pointer, graduated scale and pointer for standard. Standard setting changed by turning knurled knob under indicating dial. Sensitivity may be varied. Connections for air supply and control pressure with ¼-in. copper tubing. — *Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.*



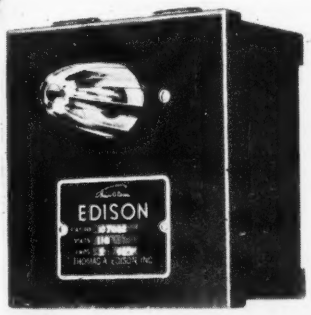


Pressure and Relief Control

Two types, Model A, super control, and Model B, standard. Unit used for keeping hot-water systems filled with water and relieving excess pressure automatically. Combination of relief valve and reducing valve.—*Penberthy Injector Co., 1242 Holden Ave., Detroit, Mich.*

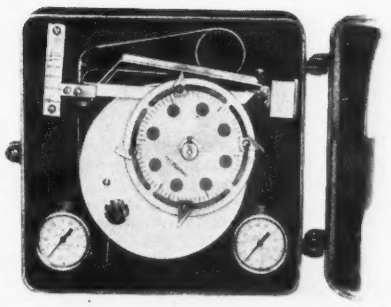
Temperature Control Unit

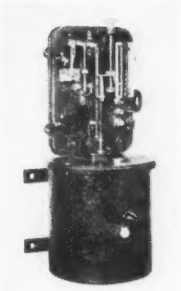
GLASS - INCLOSED thermostat mounted with guard in cover of standard 4x5-in. switchbox operates glass-inclosed relay in box, rated at 400 watts in temperature-control units for use in dead-air spaces. — *Thomas A. Edison, Inc., West Orange, N. J.*

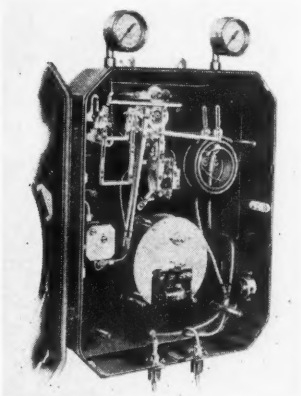


Time-Cycle Controller

CONTROLS automatic, intermittent operation of diaphragm valves or other diaphragm-operated devices. Simple, dependable, adaptable, low in price. Called "Intermitter," and limited to repetition of one operation. Up to 20 lugs can be used. Spring or electric clocks. Two types, direct-acting, in which lugs open nozzle to relieve pressure from diaphragm motor, and reverse-acting, in which lugs close nozzle to apply pressure.—*Taylor Instrument Companies, Rochester, N. Y.*





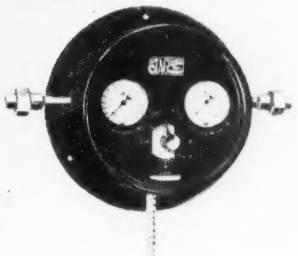


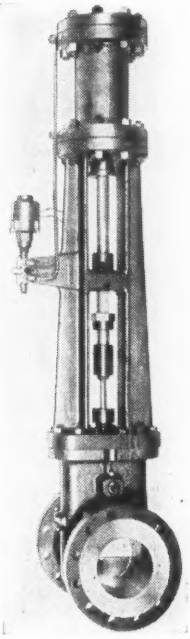
Reset Controller

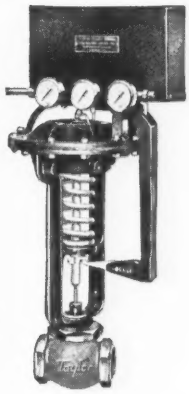
WILL control temperature, pressure, rate of flow or liquid level in a predetermined relation to some other temperature, pressure, rate of flow or liquid level. Can be used on all applications where a fixed differential must be maintained between two variables, one under control, or where control of a process must be changed in accordance with predetermined ratio to a secondary process or condition. Records both adjusting and control conditions. Maximum ratio between is 5 to 1. Both direct and inverse ratio adjustments possible. — *Taylor Instrument Companies, Rochester, N. Y.*

Controller

SPRING lever multiplies movement of capsular spring in Tag No. 40 for automatic control. Temperature change transmitted to ball air valve which resets rate of flow through diaphragm actuated control valve. Indicating and non-indicating types in nine temperature and three pressure ranges.—*C. J. Tagliabue Mfg. Co., Park & Nostrand Aves., Brooklyn, N. Y.*







Electronic Timer

ELECTRONIC timer reads directly thousandths of a second by charging condenser at known rate during interval, then measuring voltage built up on condenser. charging controlled by two Thyratron tubes to start and stop current flow. All equipment in box with terminals for connecting to 115 volts, 60 cycles, a.c., and 125 volts, d.c.—*General Electric Co., Schenectady, N. Y.*

Control System

"DUBL - RESPONSE" control system for desuperheaters compensates for load changes regardless of time lag. Precision, valve-action eliminates effects of valve-stem friction and diaphragm-motor hysteresis on accuracy. Mounted on diaphragm valve. — *Taylor Instrument Cos., Rochester, N. Y.*

Adjustable Orifice

ORIFICE automatically shifts position in accordance with major changes and rate of flow. Piston governed by solenoid-actuated valve in turn commanded by contacts made in recording meter. Through solenoid valve, hydraulic pressure is admitted to either end of cylinder, while other end opens to drain.—*Bailey Meter Co., 1050 Ivanhoe Rd., Cleveland, Ohio.*

Pyrometer Controller

(Right)

MODEL No. 478 has clean non-arcing, non-oxidizing, mercury-to-mercury electric contact sealed in glass, requires no relay. Visible operating mechanism, accessible Telechron motor, mercury switches and terminal block.—*Bristol Co., Waterbury, Conn.*

Static Pressure Control

(Left)

FOR applications requiring accurate control of low pressures up to 1 in. of water above or below atmosphere. Units may be used as positive or static pressure controllers, sub-atmospheric or draft controllers, or as differential controllers, application determining method of making pressure connections. — *Minneapolis-Honeywell Regulator Co., Minneapolis, Minn.*

WELDING EQUIPMENT

Brazing Flux

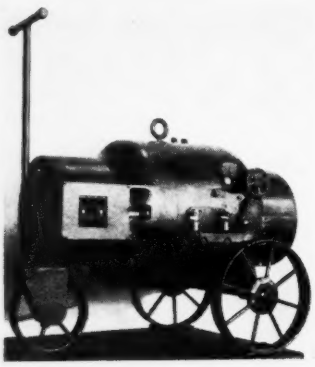
"HANDY FLUX" for low-temperature brazing is entirely liquid and active at 1,200 deg. F. Dissolves oxides formed during preheating, and works with ferrous and non-ferrous metals, permitting use of silver solders and brazing alloys with low-flow points. Flux begins to fuse at 900 deg. F., and works effectively with alloys having flow points from 1,200 to 1,600 deg. F.—*Handy & Harman, 82 Fulton St., New York, N. Y.*

Welding Cable

FINE tinned-copper wire laid in ropes; "Realwear" cable insulated with rubber compound, covered by woven cotton joined to rubbre belt by special process for cover. Sizes from No. 2 to 4/0. — *Lincoln Electric Co., Cleveland, Ohio.*

50-Amp. Vertical Welder

W50-254 low-current arc welder has stable high-speed arc, permitting it to weld quickly and efficiently down to 26-gage steels. Motor-generator unit with 3-hp. squirrel-cage motor operates on any a.c. power, including 110-volt, single-phase.—*Harnischfeger Corp., Milwaukee, Wis.*

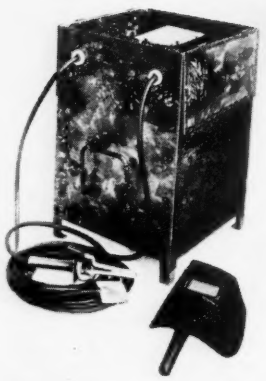


D.C. Welder

"FLEXARC" d.c. welder with single-dial preset control sets current to maintain constant arc despite speed changes of driving motor. Open-circuit voltage below hazardous values provides safety for operator, yet retains desirable arc characteristics. Set adjusts itself to preset value when arc is struck. To set welding current, operator turns handwheel until current dial geared to handwheel shaft reads desired value. Squirrel-cage induction driving motor.—*Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.*

Educational X-Ray Unit

CONSISTS of a lead-lined cabinet enclosing 200,000-volt x-ray generator and air-cooled tube. Rays escape through variable opening in top. Specimen box fits over top of base cabinet.—*St. John X-Ray Service, Inc., 30-20 Thomson Ave., Long Island City, N. Y.*

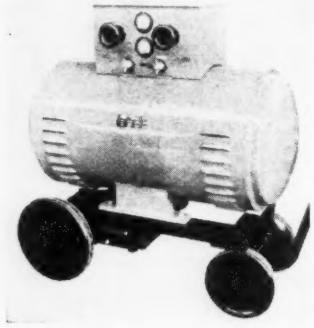


Arc Welder

A.C. WELDER for metals down to 26-gage steels, complete with leads, hand shield and handles. Three sizes: 15 to 150 amp., for 1/16 to 5/32-in. rods; 15 to 275 amp. for 1/16 to ¼-in. rods, and "junior welder," 15 to 90 amp., for small power service.—*Miller Electric Mfg. Co., Appleton, Wis.*

Arc Welder

UNITY power factor motor drive is claimed to provide 10 to 15% better over-all efficiency. Separate auxiliary differential field structure produces improved performance. Oscillograph tests show recovery from short circuit to normal welding current in less than 0.01 sec. Dual control system, polarity reversing switch and zero center individual current and voltage meters. Also for motor or engine drive. Noel "Speed Arc."—*Ideal Electric & Mfg. Co., Mansfield, Ohio.*



Engine-Driven Welder

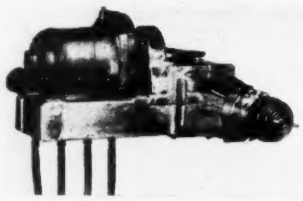
"200-AMP., Shield-Arc Special" welder has current range from 60 to 250 amp. Single-operator, variable-voltage type generator with completely laminated magnetic circuit and interpoles. Power from Waukesha 4-cyl., 23-hp., 1,400-r.p.m. engine.—*Lincoln Electric Co., Cleveland, Ohio.*

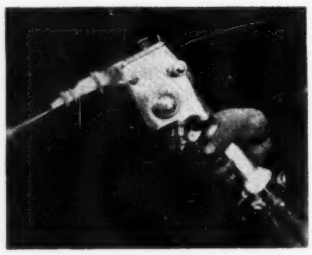
Medium Pressure Acetylene Generators

THREE sizes of Oxweld MP-5 for stationary service have capacities from 300 to 1,000 cu.ft. per hr. Self-contained gravity-type feed control bolted to inside of upper section.—*Linde Air Products Co., 30 E. 42nd St., New York, N. Y.*

Metal Spray

METAL spray device for mounting on lathe toolpost or other holding fixture feeds standard-gage No. 9 wire at 11 to 35 lb. per hr. Driven by a 1/6-hp. motor. Uses acetylene gas, oxygen and compressed air.—*Gillord Sales Corp., 420 Lexington Ave., New York, N. Y.*





Metal Atomizer

METAL atomizer for metallic protective coatings has special positive feed, permitting wire-speed variations to cover all necessary ranges without changing gears.—*Coen Co., 916 Bryant St., San Francisco, Calif.*

Welding Blowpipe

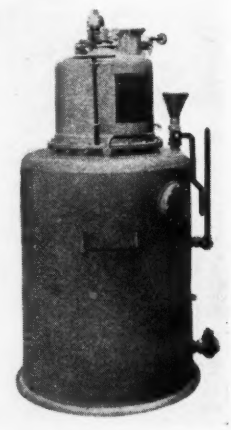
EXTRUDED brass, Monel metal, and drawn copper with silver-soldered tubes, Purox welding torch No. 35 has ribbed design on handle to reinforce and give easier grip. Hexagonal socket arrangement permits head to be assembled in six positions.—*Linde Air Products Co., 30 E. 42nd St., New York, N. Y.*

Cable Connectors

PERMIT welding cable to be made up in standard-length sections. Have metal parts machined from bar brass and insulated in special composition casing. Two ratings, 400 and 600 amp.—*Dallett Co., 165-189 West Clearfield St., Philadelphia, Pa.*

100-Amp. Welder

SMALL, low-priced motor-generator type machine welds thin-gage material. Called SA-100 and delivers as low as 30 amp. at arc. Current 30 to 125 amp. Usually 220 or 440 volt, but available for 100 or 550 volt, 3 or 2 phase, 60 and 50 cycles.—*Lincoln Electric Co., Cleveland.*



Acetylene Generator

SMALL-SIZE, portable or stationery. Oxweld Type MP-6-Medium Pressure, has 50-lb. carbide capacity with double rating of 100 cu.ft. of acetylene per hr. Acetylene at any pressure up to 14 lb. per sq.in. may be obtained.—*Linde Air products Co., 30 East 42nd St., New York, N. Y.*

Acetylene Cylinder Manifold

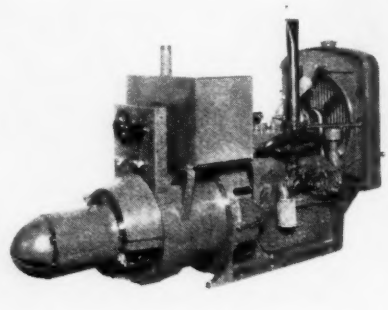
WALL-TYPE "Oxweld Type M-8" available in 10-cyl. units, to which extensions in units of five or ten cylinders can be made. Piping system at pressures up to 15 lb. per sq. in.—*Linde Air Products Co., 30 East 42nd St., New York, N. Y.*

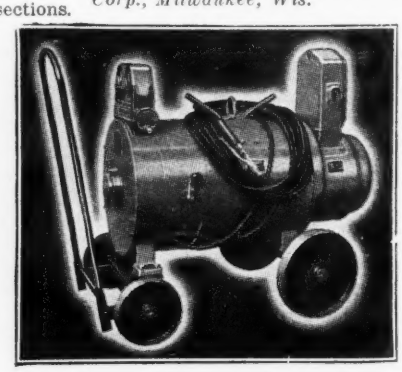
Cable Connector

QUICK - DETACHABLE connector locks in position. Plug inserted in jack, locked by twist.—*Lincoln Electric Co., Cleveland.*

Arc Welder

"HEAVY DUTY" welder available for standard or special voltage of 2- or 3-phase, 60- or 50-cycle current. Also gasoline-powered units and stationary and portable mountings.—*Harnischfeger Corp., Milwaukee, Wis.*





Welding Rod

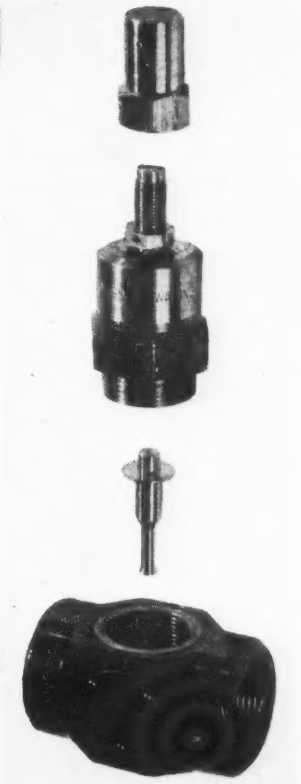
STAINLESS steel rod for welding 18-8 chrome-nickel steels, known as Oxweld No. 28 Columbium-Treated 18-8 Rod.—*Linde Air Products Co., 30 East 42nd St., New York, N. Y.*

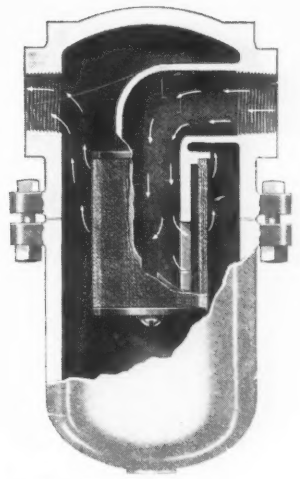
Hard-Metal Electrode

"ABRASOWELD" hard - surfacing electrode is designed for building up straight carbon steel, low alloy or high-manganese steel surfaces to resist abrasion. Maximum hardness only at surface where it is cold-worked. Moderate peening raises hardness to about 50 Rockwell C, and surface must be ground to shape. 3/16-in. size, 14 in. long. —*Lincoln Electric Co., Cleveland, Ohio.*

Hardfacing Electrode

"TOOLWELD" deposit equivalent to high-speed steel retains hardness of 55 to 65 Rockwell C under temperature up to about 1,000 deg. F.; 14-in. lengths in four sizes, 3/32 in., ⅛ in., 5/32 in. and 3/16 in. 5-lb. containers. —*Lincoln Electric Co., Cleveland, Ohio.*

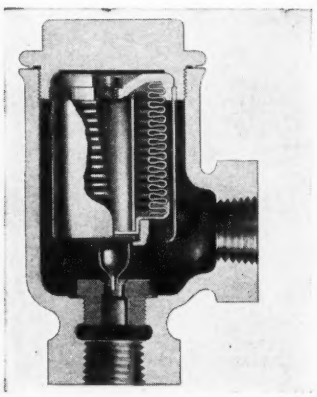




Screen Separator

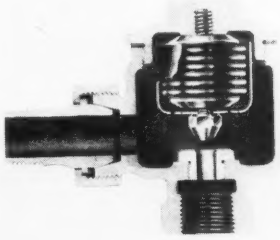
WATER and oil removed from steam or air by "Type S" which utilizes Gast patented principle of zig-zagging moisture and oil-laden vapor through several layers of coarse-mesh screen. Pressures to 150 lb. Installed in line. Sizes ¾ to 2 in.—*Johnson Corp., Three Rivers, Mich.*

STEAM TRAPS



Thermostatic Steam Trap

No. 9-200, for steady or fluctuating pressures from 0 to 200 lb., designed for draining high-pressure steam coils, as well as removing condensate. No adjustment for change of steam pressure. Thermostatic bellows is helically corrugated tubing with heavy wall. Body and cap cast bronze. No gasket. Valve head and seat stainless steel, renewable. Three sizes, ½, ¾ and 1 in., with capacities 900 to 3,300 lb. of water per hr. at 200 lb.—*Sarco Co., Inc., 183 Madison Ave., New York, N. Y.*



Steam Trap

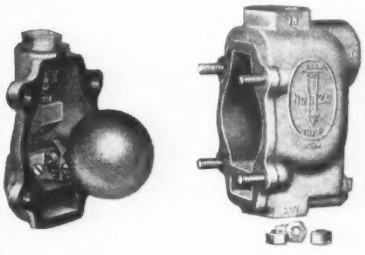
STYLE "AU" TRAP has union connection and is of bronze, for use on radiators and unit heaters where reduced high-pressure steam is used. Pressure up to 150 lb. Style "C" is cast iron for pressures up to 200 lb., and in angle type so trap drains itself when steam is turned off. Valves and seats hardened stainless steel.—*W. H. Nicholson & Co., 213 Oregon St., Wilkes-Barre, Pa.*

Trap With One Moving Part

EXTREMELY compact, machined entirely of bar stock (steel, Tobin bronze and Monel). No thermostatic or float elements. Sole moving part is Monel piece. Yarway impulse trap now made in six sizes: ½ in., ¾ in., 1 in., 1¼ in., 1½ in., and 2 in. But one pattern in each size, making for simplicity of stocking and ordering. As factory adjusted, this single pattern is suitable for all steam pressures up to 600 lb., and for a substantial range of back pressures. Body length 3¼ in., total weight 2½ lb., capacity ranging from 1,360 lb. per hr. at 10 lb. pressure to 4,380 at 600 lb.—*Yarnall-Waring Co., Mermaid Ave., Philadelphia, Pa.*

Oil Separator

TYPE RV purifier to remove oil from exhaust steam has two separating stages. First recovers bulk of entrainment, while second acts as refining stage.—*Centrifix Corp., 3029 Prospect Ave., Cleveland, Ohio.*



Steam Trap

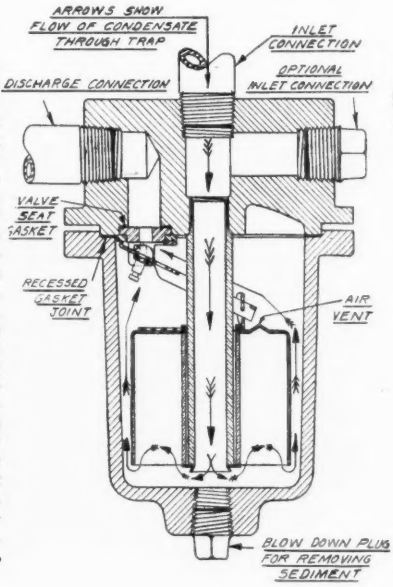
COMBINATION float and thermostatic steam trap, has working mechanism on cover with piping connections on body. Reversible stainless-steel valve and seat. Six capacities.—*American District Steam Co., North Tonawanda, N. Y.*

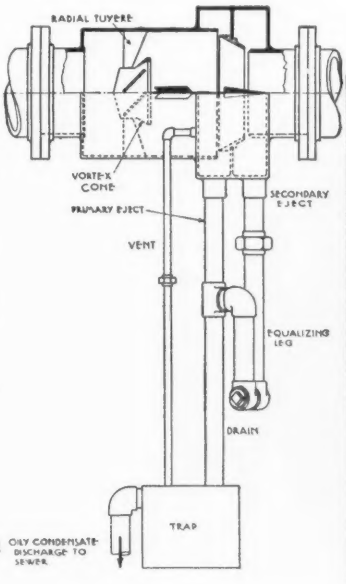
Forged-Steel Strainer

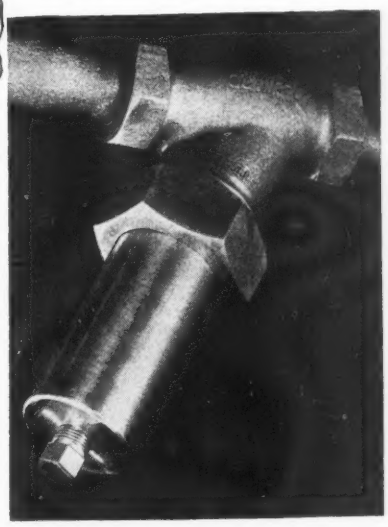
DESIGNED for high pressure-temperature service, but available for lower pressures and temperatures. Standard removable strainers perforated Monel metal. Threaded cleaning plug provided.—*Edward Valve & Mfg. Co., Inc., East Chicago, Ind.*

Steam Trap

SUPER-SILVERTOP inverted-bucket trap requires no pipe fittings. Two inlet connections at right angles, so trap may be used as an elbow or straight in line. Inspected or cleaned without disturbing pipe. Cross-section shows valve open. Four sizes, for ½ to 1¼-in. pipe, maximum gage pressures of 150 to 250 lb. Minimum capacity of smallest unit at 1-lb. operating pressure is 200 lb. of water per hr., of largest size at 250-lb. operating pressure, 9,600 lb. of water per hr.—*V. D. Anderson Co., 1935 West 96th St., Cleveland, Ohio.*







MANUFACTURERS' NEW LITERATURE

For your convenience, the following pages list practically every power-field bulletin and catalog issued in 1935. To get background data for specifying equipment, go through the list now and check on the coupon the literature you need

E. J. Tangerman,
Associate Editor, POWER,
330 W. 42nd St., New York, N. Y.

TO THE READER: Use this convenient coupon to get bulletins you need now.

Please send me the bulletins indicated by number below:_____

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Position_____ Your Address_____

BOILERS, REFRACTORIES AND ACCESSORIES

A1. Boilers—Combustion Engineering Co., Inc. 4-page folder lists and illustrates products for boiler plants.

A2. Boilers—Henry Vogt Machine Co. Series of boiler bulletins covering three- and four-drum curved-tube boilers.

A3. Boilers—Combustion Engineering Co., Inc. Folder describing VM boiler for small and medium sized plants.

A4. Boilers—Springfield Boiler Co. 40-page catalog 35 describes installations of all-steel sectional boilers.

A5. Radiant-heat Boilers — Union Iron Works. 6-page bulletin on radiant-heat boilers shows several typical installations and gives operating data.

A6. Water-Tube Boilers—Springfield Boiler Co. 40-page catalog 350. Recent installations and "Suggested Rules for Care and Operation of Power Boilers."

A7. Boiler Chemicals—Monsanto Chemical Co. 24-page monthly "Current Events."

A8. Boiler Scale Control—D. W. Haering & Co., Inc., Bi-monthly house organ, "H-O-H News."

A9. Boiler-Feed Control—Northern Equipment Co. Folder 137, illustrated paper by E. G. Grady on "Operating Experience at Masonite With High-Pressure Boiler Feed Control."

A10. Baffling—Power Plant Efficiency Co. 2-page bulletin 26, "Select Your Boiler Baffling Carefully," engineering information.

A11. Refractories — Laclede-Christy Clay Products. 5 bulletins on refractory materials, including bricks, mixes, plastics, etc.

A12. Refractories — General Refractories Co. 118-page catalog (6th edition) on line of refractory products.

A13. Refractories — General Refractories Co. Series of 10 booklets on company products and field.

A14. Refractories—M. H. Detrick Co. 15-page, well-illustrated booklet on boiler arch and wall construction.

A15. Refractory Products—Plibrico Jointless Firebrick Co. 32-page general catalog covering jointless firebrick and other refractory products.

A16. Refractory Insulating Brick—Chas. Taylor Sons Co. Booklet giving engineering data, comparative tests and performance reports on refractory insulating brick.

A17. Furnace Lining and Arches—McLeod & Henry Co. Catalog 235, 32 pages, covers design installation and service advantages for modern boiler furnaces.

A18. Heat Insulation — Harbison-Walker Refractories Co. Bulletin, "Insulate With Safety at any Temperature," describes brick for services up to 2,900 deg.

A19. Chrome Brick—General Refractories Co. Pamphlet, "A New Application of the 'Ritex' Process to the Manufacture of Chrome Brick," by R. P. Heuer.

A20. Refractory Cement—Norton Co. 8-page leaflet No. 863 gives data and illustrations of refractory cement. Also conversion and melting-point tables.

A21. Refractory Cement—Johns-Manville. 12-page "Fire Tamers" describes research on refractory material.

A22. Mortar Bonds—Ironton Fire Brick Co. Circular No. 3 gives properties and uses of a high-temperature cement.

A23. Bonding Mortars—Harbison-Walker Refractories Co. Three folders describing three high-temperature bonding mortars.

BLOWERS, FANS, COMPRESSORS

B1. Blowers — Roots-Connersville Blower Corp. 8-page Bulletin 22:23-B10 on standard and heavy-duty blowers, discussing inherent characteristics and operating principles of rotary positive type.

B2. Compressors — Chicago Pneumatic Tool Co. Bulletin No. 759 on 2-stage air-cooled compressors, motor- or belt-driven.

B3. Compressors — Worthington Pump & Machinery Corp. Bulletin No. L-611-B3 on compressors for raising steam pressure beyond capability of boiler.

B4. Compressors — Worthington Pump & Machinery Corp. Bulletins L-611-B4A and 5A on "Single Horizontal, Single-Stage, Steam- and Motor-Driven Compressors."

B5. Compressors — Worthington Pump & Machinery Corp. 4-page leaflet describing single-stage vertical air compressors. Bulletin No. L-621-B6.

B6 & 7. Compressors—Ingersoll-Rand Co. 48-page catalog describing Type XPV steam-driven air or gas compressor. Also 32-page catalog covering "Type 30" industrial compressors and vacuum pumps, ¼ to 15 hp., pressures to 1,000 lb.

B8. Compressors — Carbondale Machine Corp. 12-page booklet on horizontal single and duplex compressors, single-stage and two-stage types, steam- and motor-driven. Bulletin No. 1100.

B9. Compressors — Carbondale Machine Corp. 6-page, 2-color folder, Bulletin 1107 describes vertical, duplex refrigeration compressors. Specifications and dimensions.

B10. Compressor—Pennsylvania Pump & Compressor Co. Bulletin 157 on Class 3-AT single-stage, straight-line roller-bearing.

B11. Compressors and Vacuum Pumps—Allis-Chalmers Mfg. Co. Bulletin No. 2171 describes rotary air compressors and dry-vacuum pumps for pressures to 10 lb. gage and vacuums to 18 in. of mercury.

B12. Air Compressors—Sullivan Machinery Co. 32-page catalog describes Plus Portable 2-Stage Air-Cooled Compressors in four sizes, 105, 106, 210 and 315 cu.ft., driven with gasoline engines or diesels.

B13. Compressed-Air Accumulator—Seamless Steel Equipment Corp. 4-page bulletin, "Hydraulik" Accumulators, units without pistons or floats, also hydraulic presses made by Hydraulik G.m.b.H., Duisburg.

B14. Hydraulic Accumulators — Seamless Steel Equipment Corp., "Hydraulik Accumulators" describes compressed-air accumulators for use on hydraulic service.

FUEL-BURNING EQUIPMENT

C1. Stokers—Combustion Engrg. Co. 16-page Catalog E-8 describes Type E center-retort underfeed stoker. Also typical ash-pit and air duct arrangements.

C2. Stoker—Combustion Engineering Co., Inc. 8-page bulletin on "Design MRO" multiple-retort stoker. Test data and operating results.

C3. Stokers—Link-Belt Co. Two folders, No. 1458-9, contain data on underfeed screw stokers to 3,000 sq.ft.

C4. Stokers—McClave-Brooks Co. 8-page leaflet on forced-draft chain-grate stoker and operating mechanisms.

C5. Stokers—Whitty Mfg. Co. Three new bulletins for real estate, industrial and greenhouse stoker users.

C6. Combustion Control — Brooke Engineering Co., Inc. Bulletin No. 8, 8 pages, describes combustion-control system.

C7. Combustion Control—Bailey Meter Co. 32-page bulletin No. 102 shows how air-operated combustion-control is applied to boilers in sizes from 2,000 sq.ft. up.

C8. Combustion Control—Leeds & Northrup Co. Circular No. F-172-T on "Metermax" combustion-control unit.

C9. Coal-Burning — Appalachian Coals, Inc. 19-page analysis covers 7,284 plants, illustrates comparative importance of various types of coal-burning equip. 27 tables.

C10. Gas Burners—Lee B. Mettler Co. General Catalog Section No. 7 contains numerous blueprints and installation photos.

C11. Turbo-Blowers—Allis-Chalmers Mfg. Co. 4-page leaflet No. 2180, "Single-Stage, Geared-Head Turbo-Blowers," for oil and gas-fired furnaces.

C12. History of Coal—Consolidation Coal Co., Inc. 100-page, carefully bound "History of Consolidation Coal Co., 1864-1934," covers 70 years of America's development.

C13. Coal Preparation—Link-Belt, Ltd. Book No. 1521, 32 pages, "Preparing Coal of Higher B.t.u. Value at Lowest Cost Per Ton by Applying Scientific Methods."

C14. Coal Crusher—Jeffrey Mfg. Co. Bulletin 598, 4 pages, describes "Flextooth" crusher for run-of-mine coal.

C15. Maintenance—L. J. Wing Mfg. Co. Technical article "The Possibility of Reducing Maintenance Costs Through Fuel Used," by A. E. Selling, Pres. 8-page bulletin.

HEAT-TRANSFER EQUIPMENT

F1. Heat Transfer—Young Radiator Co. 19-page catalog No. 435, contains complete technical data on heat-transfer surfaces.

F2. Heater—Ross Heater & Mfg. Co., Inc. Catalog No. 1046 selecting fuel-oil heaters and tank suction heaters.

F3. Water Heater—General Electric Co. Single sheet No. GEA-2183 on electrically controlled steam-water heater.

F4. Water Heaters — American District Steam Co. Bulletin No. 35-75, 10 pages, describes storage-type water heaters, and estimating hot-water demand.

F5. Feedwater Heaters — Worthington Pump & Machinery Corp. Bulletin W-210-B17, "Deaerating Feedwater Heaters."

F6. Feedwater Heater—Marshall Heater Co. Bulltin A describes open-type feedwater heater, purifier, and oil extractor combined.

F7. Deaerating Heaters—Cochrane Corp. Bulletin No. 700 discusses deaeration to protect piping, economizers and boilers.

F8. Superheaters—Superheater Co. 6-page folder gives 25-year history of company.

F9. Evaporators — Young Radiator Co. 4-page catalog No. 535 on evaporators for direct-expansion systems using freon and methylchloride.

F10. Tubes — A. M. Byers Co. Bulletin No. 1534, 6 pages, "Installation of Genuine Wrought-Iron Tubes."

F11. Tubes—Scovill Manufacturing Co. 4-page Bulletin No. 3 gives specifications for condenser and heat-exchange tubes.

F12. Condenser Tubes—Scovill Mfg. Co. 12-page booklet on installation methods and specifications for condenser tubes.

F13. Condenser Tubes—Scovill Mfg. Co. 4-page price list effective Oct. 23 on condencer and heat-exchanger tubes.

F14. Steel and Boiler Tubes—A. B. Murray Co., Inc. 56-page warehouse stock list.

HEATING, VENTILATING, REFRIGERATING

D1. Air-Conditioning Equipment — York Ice Machinery Corp. 6 sheets on 10-, 15-, 20-, and 25-hp. condensing units for refrigeration and air conditioning and series of horizontal-type air conditioners.

D2. Air-Conditioning—York Ice Machinery Corp. Single sheet illustrates recent department-store installations.

D3. Air Filters—Coppus Engineering Corp. A comparative product chart based on test figures on oily impingement and dry-type filters, and, second, on leading makes of dry-type filters.

D4. Air Filters — Coppus Engineering Corp. Two bulletins: F-320-3 filter for motor and generator intakes and general industrial use; F-310-2 on filters for compressors, internal-combustion engines, etc.

D5. Air Filter—Davies Air Filter Corp. Bulletin describes "Airplex" dry-cartridge filter for air.

D6. Fans—Aerovent Fan Co. 32-page bulletin gives complete data on "Macheta" airfoil fans. Applications and fan laws.

D7. Fan Assemblies—John J. Nesbitt, Inc. 59 loose-leaf pages in Bulletin No. 227, "Nesbitt Series B Thermoven" fans.

D8. Ventilating Equipment—ILG Electric Ventilating Co. Booklet C50, catalog and handbook of ventilating, heating, cooling and air-conditioning equipment.

D9. Blower-Separator—American Air Filter Co., Inc. 8-page Bulletin No. 270-H, describes "Roto-Clone" Type D Dynamic Precipitator, exhauster and dust separator.

D10. Dust—Buell Engineering Co. 8-page, two-color bulletin describes dust collection and elimination equipment, and "Van Tongeren" system.

D11. Ventilator—Burt Mfg. Co. Bulletin No. SPV-6 describes "Monovent Continuous-Ridge Ventilator." Seven sizes 3 to 24 in., in 10-ft. lengths.

D12. Heating System—Hoffman Specialty Co., Inc., Waterbury, Conn. Large 3-color folder on Hoffman "Talmadge," zoned, controlled, heating system.

D13. Electric Heating—Electric Air Heater Co. 24-page Data Book No. 236 describes heating by "Electromode" forced heat.

D14. Heating Specialties—Bishop & Babcock Sales Co. 38-page Bulletin No. 10A, "Heating Specialties," shows vacuum and vapor low-pressure heating specialties.

D15. Unit Heaters—Modine Mfg. Co. Catalog No. 635 describes unit heaters.

D16. Unit Heaters—Trane Co., 24-page two-color bulletin describes and gives specifications for unit heaters.

D17. Unit Heaters—Fedders Mfg. Co. 8-page Bulletin 527 on Series 3 unit heaters.

D18. Unit Cooler—Modine Mfg. Co. Bulletin No. 335 describes direct-expansion type cooler for installations with air- or water-cooled compressor using Freon, methylchloride, sulphur-dioxide or any other common refrigerant, except carbon dioxide.

D19. Coolers—Carbondale Machine Corp. 8-page Bulletin No. 1103 on horizontal, vertical, single- and multi-pass brine coolers.

D20. Water Cooling—Marley Co. 48-page Bulletin 54 shows outstanding water-cooling installations during nine years.

D21. Cooling Towers—Binks Mfg. Co. Bulletin No. 70 describes eight sizes of indoor forced-draft cooling towers, capacity 5 to 150 g.p.m. circulation.

D22. Cooling Towers—Research Corp. Catalog No. 255 describes line of "Coey" cooling towers for refrigeration.

D23. Spray Cooling—Binks Mfg. Co. 8-page bulletin on indoor forced-draft spray-cooling towers. Also another 8-page bulletin on atmospheric spray-cooling towers.

D24. Steam-Jet Refrigeration Standards—Carbondale Machine Co. Bulletin W.207-E17 describes new standards by Vacuum Cooling and Steam Ejector Section of Heat Exchange Institute.

D25. Purge Drum—York Ice Machinery Corp. Sheet No. SP-35250 on thermostatic purge drum for elimination of air and non-condensable gases in refrigerating system.

D26. Gas Separator—Hill Mfg. Co. 4-page bulletin "Reduce Your Operating Costs With a Hill Improved Float-Type Non-Condensable Gas Separator."

Materials

E1. Insulation — Johns-Manville, 8-page folder, IN-36A, "Guardian of the B.t.u." on thermal-insulation research.

E2. Insulation—Johns-Manville. 64-page pocket-size booklet on insulating products.

E3. Thermal and Sound Insulation—General Insulating & Mfg. Co. 16-page general catalog No. 1935-A. Illustrates line of insulating materials.

E4. Sound Insulation — Johns-Manville. Illustrated booklet No. DS Series 275 discusses sound control in air-conditioning.

E5. Metal Insulating Material—American Flange & Mfg. Co., Inc. 8-page folder "Ferro-Therm—New in Insulation."

E6. Steel Insulation—American Flange & Mfg. Co. "Testing Sheet-Steel Insulation."

E7. Roofs—Johns-Manville. Two bulletins, "3 Modern Developments," "What About Your Roofs?" discuss construction and maintenance of industrial roofs.

E8. Roofing—Johns-Manville Co. 22-page Catalog No. BU-20A, gives complete details on line of roofing materials and methods.

Instruments

E9. Air Measurements—Julien Friez & Sons, Inc. Bulletins describe air and air-conditioning instruments; Bulletin K, air-conditioning products; Bulletin S, standard measuring and recording instruments; Bulletin L, thermometers; Bulletin M, "Red Top" thermo-regulators.

E10. Air-Conditioning Equipment — Julien P. Friez & Sons, Inc. Bulletin G details portable recording instruments for relative humidity, temperature, etc.

E11. Thermometers — Leeds & Northrup Co. Bulletin No. 4001. 24-page booklet giving information on 3-lead, mull-type, electrical-resistance thermometer for use in air-conditioning systems.

E12. Thermostat—Julien P. Friez & Sons, Inc. Bulletin A/X describes thermostat for operating heating and cooling equipment.

E13. Thermostats and Humidistats — Julien P. Friez & Sons, Inc., Bulletin No. AT/I. Supplementary wiring diagrams Nos. 1 to 11 for thermostats, humidistats.

E14 and 15.—Humidistats and Controls—Julien P. Friez & Sons, Inc. Two bulletins, "A" describes wall-mounting and insertion-type Humidistats and "AT/R" on relays and control assemblies for use with Humidistats, thermostats, etc.

E16. Humidity Control — Research Corp., Calorider Div. Bulletin No. 1 describes system for control of effective temperature, air purity and humidity.

E17. Wind Equipment—Julien P. Friez & Sons, Inc. 16-page bulletin describes instruments for determining and recording wind.

MECHANICAL TRANSMISSIONS

G1. Mechanical Transmission — Medart Co. 144-page catalog No. 56-T on mechanical transmission equipment.

G2. Industrial Power Transmission — Power Transmission Council. 36-page bulletin, "A Practical Analysis of Some Fundamental of Industrial Power Transmission."

G3. Speed Control — Reeves Pulley Co. 112-page Speed Control Handbook describes methods of variable speed regulation, typical applications.

G4. Variable-Speed Control—Reeves Pulley Co. 6-page folder, "Inside Facts About Variable Speed Control," describing interiors of Reeves speed units.

G5. Variable-Speed Drives—Westinghouse Electric & Mfg. Co. 10-page illustrated booklet No. 2050 on "New Departure" variable-speed "Transitorq".

G6. Variable-Speed Transmission — Vickers, Inc. Bulletin No. 35-T8 describes hydraulic variable-speed transmissions.

G7. Reducer — Link-Belt Co. Book No. 1519, 32 pages, on herringbone gear reducer for heavy and shock loads.

G8. Worm Reducer—Link-Belt Co. Book No. 1524, 40 pages, gives complete data on worm-gear reducers.

G9. Speed-Reducing Gear Units—Dominion Engineering Co., Ltd. 24-page Bulletin 127, "Dominion Standard Speed-Reducing Gear Units."

G10. Speed Reducers—D. O. James Mfg. Co. 12-page circular, "The World's Largest Post Office Completely Equipped with D. O. James Speed Reducers."

G11. Motorized Speed Reducers—Link-Belt Co. 20-page catalog No. 1515 on speed reducers, with motor mounted directly on side of reducer housing.

G12. Couplings—Smith & Serrell. Bulletin No. 49 describes 21 regular sizes of "Flexpin" couplings.

G13. Couplings—Link-Belt Co. Book No. 1545, 8 pages, technical data on flexible couplings.

G14. Couplings—John Waldron Corp. 4-page Bulletin No. 51 describes and gives ratings and dimensions for cross-type, flexible couplings.

G15. Flexible Couplings — Baldwin-Duckworth Chain Corp. Bulletin No. 55 describes flexible chain coupling and standard semi-flexible type.

G16. Flexible Couplings—F. A. B. Mfg. Co. Bulletin describes "Fabco" Type R line-and-pin type flexible couplings.

G17. Flexible Couplings — John Waldron Corp. 12-page Catalog No. 50 describes changes in "Francke" flexible couplings. Includes also sizes, directions for selection, and service factors.

G18. Bearings—Link-Belt Co. Book No. 1494, 12-pages, illustrated, covers "Shafer self-aligning roller bearing, Series 400."

G19. Bearings—S K F Industries, Inc. 32-page catalog shows load ratings and diagrams of mountings for ball-and roller-bearing pillow blocks, flanged housings, etc.

G20. Bearings—S K F Industries, Inc. 10-page Bulletin No. 230 and four single sheets on bearings for main spindles.

G21. Bearing Housings—R-S Products Corp. Data sheet on closures for bearing housings of all shapes and types.

G22. Pillow Blocks—SKF Industries, Inc. 8-page bulletin No. 233 illustrates and shows applications for Pillow Blocks.

G23. Fans and Blower Bearings—S K F Industries, Inc. 8-page bulletin No. 232 illustrates method of applying ball bearings to fan and blower boxes.

G24. Gears—Westinghouse Electric & Mfg. Co. 16-page booklet No. 2041 on "Micarta" gear material.

G25. Link-Grate Stokers — Westinghouse Electric & Mfg. Co. 40-page booklet No. C.2003 on continuous-ash-discharge, link-grate stokers.

Belt Drives

G26. Belt Drive—E. F. Houghton & Co. 16-page booklet, "Vim Short-Center Drive With Vim-Tried Leather Belting."

G27. Short-center Drive—E. F. Houghton & Co. A complete handbook on short-center drives.

G28. V-Belt Driver—Gates Rubber Co. 48-page bulletin No. DH-300 contains data for care and design.

G29. Belts—Manhattan Rubber Mfg. Division. 4-page Bulletin No. 6808-B, describes construction of "Condor" compensated belt.

G30. Rubber Belts—B. F. Goodrich Co., Sales Promotion Dept., Mechanical Div. Folder lists 14 improvements in belt construction during past five years.

G31. Transmission Belting—B. F. Goodrich Co. 28-page catalog, including directions for making Plylock belt joint.

G32. V-Belts—L. H. Gilmer Co. V-Belt Catalog JS-215 for multiple-groove and fractional horsepower drive.

G33. V-Belts—Manhattan Rubber Mfg.

Division of Raybestos-Manhattan, Inc. Bulletin No. 6840, 4-page leaflet, describing "Condor" V-belts.

G34. Belt Preservatives—E. F. Houghton & Co., 12-page folder contains helpful information on how, when and why to use belt preservatives.

Chain Drives

H1. Chain Drives—Link-Belt Co. Folder No. 1444 on "Silversteak" silent chain and No. 1445 on "Silverlink" roller chain.

H2. Chain Drives—Link-Belt Co. 32-page Book 1425. Pictorial presentation of "Silverstreak" silent-chain drive applications.

H3. Power Transmission—Morse Chain Co. Booklet illustrates typical applications of chain drive.

H4. Speed Changer—Link-Belt Co. Book No. 1574 describes line of variable-speed transmissions, integral motor if desired.

H5. Chains and Sprockets—C. O. Bartlett & Snow Co. Bulletin No. 74 on standard drop forged chain and attachments.

H6. Chains and Sprockets — Baldwin-Duckworth Chain Co. Catalog K-1, on Chains and Sprockets for Power Transmission, Conveying and Elevating.

H7. Gears & Sprockets—Medart Co. 80-page Catalog 56-G, containing standard listings, weights and dimensions on gears, sprockets and chain.

METERS, RECORDERS AND TESTING INSTRUMENTS

J1. Instruments — Brown Instrument Co. 8-page "Here is an Operating Cost that is Controllable," describes instruments.

J2. General-Purpose Meters—Foxboro Co. 6-page folder "I've Waited Years for a Meter Like This One."

J3. Instruments — Foxboro Co. 8-page folder on temperature, pressure, flow, humidity and liquid-level recorders.

J4. Meters — Foxboro Co. 8-page folder No. 677 shows various flowmeters and applications.

J5. Instruments — Brown Instrument Co. Folder describing instruments for measuring flows, temperatures, drafts, etc.

J6. Long-Distance Metering — Bristol Co. Bulletin 424 covers equipment for telemetering with simple 2-wire circuits.

J7. Flowmeters — Brown Instrument Co. 8-page folder No. 80-34-60 pictures various flow meters and recent installations.

J8. Flowmeters—Cochrane Corp. Bulletin No. 701 describes electric flowmeters for steam, liquids and gases.

J9. Flowmeters — Schutte-Koerting Co. 26-page bulletin 18-R, describes "Rotameters," for measurement of flow.

J10. Flowmeter—American Meter Co. Bulletin E-3 describing "Metric Indicating Flowmeter."

J11. Thermometers—C. J. Tagliabue Mfg. Co. 24-page catalog No. 1125 on industrial thermometers.

J12. Gages—Hays Corp. Catalog PGA-35 covering dry-type pointer draft gages, inclined-tube, direct-reading, U-tube and vernier-scale gages and dry-type draft recorders.

J13. Draft Gages—Hays Corp. "Bulletin 2018," Hays "Draftrol" Electric Contact Gages for Indicating and Controlling Draft, Pressure and "Differential Draft or Pressure."

J14. CO_2 Recorder—Leeds & Northrup Co. Application Bulletin No. 23-101, 12 pages, shows how Micromax a.c. potentiometers are used to record CO_2 of flue gas.

J15. Water Meter — Worthington-Gamon Meter Co. Bulletin M-975-B31, 8 pages, on Model R, split-case type, disk water meter.

J16. Boiler Meters—Bailey Meter Co. 4-page mailing piece gives advantages of boiler meters.

J17. Boiler Water-Level Indicators—Yarnall-Waring Co. Supplement WG-1804 gives information on Eye-Line Indicator.

J18. Water-Level Detector — Diamond Power Specialty Corp. Single-sheet Bulletin No. 848A shows boiler water-level detector.

J19. Pyrometers — Russell Electric Co. Bulletin describes portable or lance-type pyrometers.

J20. Pyrometers—C. J. Tagliabue Mfg. Co. 8-page folder, "A Beam of Light, A Mirror-Galvanometer, A Photoelectric Cell," describes pyrometers and performance.

J21. Pyrometers—Thwing Instrument Co. Leaflet A-3410 describes small single and multiple pyrometers.

J22. Pyrometer — The Pyrometer Instrument Co. "Pyro Immersion Pyrometer," is leaflet describing portable self-contained pyrometer, with reading dial attached.

J23. Potentiometer Pyrometer — Bristol Co. Catalog No. 1450 describes wide-strip pyrometer available in single-record, multiple-record, and recorder-controller type.

J24. Pyrometer Motor—Foxboro Co. Bulletin No. 202 describes Type H motor installations where Foxboro potentiometer control pyrometers are used singly or in pairs.

J25. Recorders—Hays Corp. Bulletin No. 2017 on Series "OT" and "OH" draft pressure and differential recorders for ranges between 0.1 in. and 100 in. water scale.

J26. Recorder — Leeds & Northrup Co. Circular No. 314-1 shows actual chart for multi-color strip chart recorders of two, three, four or six points.

J27. Recording Meter—Morey & Jones, Ltd. Bulletin No. B-101 describes MJL No. 37 recording meter which records rate of flow directly on suitable square-root chart.

J28. Gas-Testing Apparatus — American Meter Co., Inc. Catalog AG-2 (bulletins AG-1 to AG-6) describing meter provers, calorimeters, recording and indicating-demand meters, gages, service cleaners, etc.

J29. Testing Kits — National Aluminate Corp. Circular describes construction, content, and gives prices of "Nalco" colorimetric testing kits.

WELDING EQUIPMENT

K1, 2, 3. Welding—General Electric Co. Bulletins GES-1070, Applications and Characteristics of Welding Electrodes; 1184, Heavily Coated Electrodes; GEA-1440D, Arc Welders.

K4. Welding — Harnischfeger Corp. 24-page Bulletin HW-4, covers P&H-Hanson arc welders from 50 to 800-amp. units, welding fixtures and accessories.

K5 & 6. Welding—Lincoln Electric Corp. Two bulletins: No. 5M835, "Automatic Arc Welding by the Electronic Tornado." Bulletin No. 20M-9-35, "Arc Welding Electrodes & Accessories," contains numerous photos of equipment and applications.

K7. Welding—Linde Air Products Co. 8-page booklet on repair of cast-iron machinery by oxy-acetylene welding.

K8. Steel Welding—Linde Air Products Co. Physical and chemical principles involved in oxy-acetylene welding steel.

K9, 10. Welding Equipment — Linde Air Products Co. Two new booklets. Revised edition of "Precautions and Safe Practices" discusses subjects in relation to oxy-acetylene welding and cutting. "Recommended Practices for Gas Cutting of Structural Steel" sets up qualifications for predetermination of good workmanship.

K11. Welders — Westinghouse Electric & Mfg. Co., single sheet No. L.20555-B on "FlexArc" engine-driven welders for 200 to 400 amp. bare or coated electrodes.

K12. Arc Welders—Lincoln Electric Co. Welder Specification Bulletin No. 302, general classifications for d.c. motor-driven, Types SA300, SA400, SA600 portable welders.

K13. Arc Welder—Lincoln Electric Co. One-sheet bulletin No. 308 gives specifications on a.c. motor-driven welders, types SAC-300-SAC-500.

K14. Welding Rods—American Manganese Steel Co. 6-page leaflet No. 20 describes Amsco hard-facing welding rods Nos. 459 and 217.

K15. Welding Rod—American Manganese Steel Co. 6-page Bulletin No. 10 on welding with "Amsco" nickel-manganese steel rods.

K16. Welding Ships—Lincoln Electric Co. 4-page leaflet pictures wide variety of boats and ships constructed by "Shield-Arc" welding.

K17. Thermit Welding—Metal & Thermit Corp. 16-page pamphlet No. 18b gives principles, properties and costs of thermit welding.

K18. Brazing Flux—Handy & Harman. Bulletin on "Handy Flux" for low-temperature brazing.

K19. Metal Spraying—Metallizing Co. of America. 4-page pamphlet covers use of metal-spraying equipment on general maintenance applications.

K20. Metal Spray—Metal Spray Co. Three bulletins, Nos. 323, 351, 500, discuss applications and equipment.

K21. Metal-Spraying Equipment — Metals Coating Co. of America. Two bulletins. 8-page "MetaLayer, A Process and Equipment for Applying Sprayed-Metal Coatings," summarizes data on process. 4-page Bulletin 1202 shows accessory equipment.

K22. Metal Atomizer—Coen Co. 4-page illustrated folder explaining applying sprayed molten metal and showing equipment needed.

MOTORS, ELECTRICAL AND ELEVATOR EQUIPMENT

Motors and Generators

L1. Motors and Generators — Allis-Chalmers Mfg. Co. 4-page leaflet No. 2183 on Type E d.c. motors and generators.

L2. Motors—Allis-Chalmers Mfg. Co. Leaflet 2100 on wound-rotor induction motors.

L3 & 4. Motors—Reliance Electric & Engineering Co. Two 4-page bulletins on squirrel-cage induction motors, No. 118 for motors of 1 to 25 hp. and No. 119 for 25 to 150 hp.

L5, 6, 7, 8, 9, 10, 11. Motors—General Electric Co. Bulletin GEA-1368A, Vertical Hollow-Shaft, Induction Motors for Deep-Well Pumping; -246D, "7500 Series," High Speed Synchronous Motors; -978A, High-Speed Induction Motors for Direct Connection; -1336C, General-Purpose, Squirrel-Cage Induction Motors, Type KF; -1383B General Purpose, Squirrel-Cage Induction Motors, Type K; -1542B, Type B, d.c. Adjustable and Constant-Speed Motors; -2090, Face- and Flange-Type End Shields for G.E. Motors.

L12. Motors—Louis Allis Co. 24-page bimonthly "The Louis Allis Messenger," on maintenance of electric motors. Includes engineering data and technical articles, as well as general subjects.

L13, 14, 15. Motors—Louis Allis Co. Three new bulletins: Bulletin No. 507 on d.c. motors, Bulletin 510 on totally-inclosed, fan-cooled motors, and Bulletin 514 on single-phase capacitor motors.

L16, 17. Motors—Reliance Electric & Engineering Co. Two four-page, two-color bulletins on fully-inclosed fan-cooled induction motors for two- and three-phase circuits, Bulletin No. 120 for 2 to 15 hp. (1150 r.p.m.) and No. 121 for 20- to 100-hp. (1200 r.p.m.).

L18. Motors—Harnischfeger Corp. Bulletin No. HM1 on squirrel-cage and slip-ring industrial motors up to 125 hp.

L19. Motors — Westinghouse Electric & Mfg. Co. 6-page illustrated catalog section No. 43-349 on Type ADS position motors.

L20. Alternators—Allis-Chalmers Mfg. Co. 24-page Bulletin No. 1153-A on engine-type alternators.

L21. Induction Motors — Allis-Chalmers Mfg. Co. Leaflet 2182 describes new steel-clad induction motor.

L22. Motor Price Wheel — Louis-Allis Co. Circular slide rule, printed in colors on heavy cardboard, tells frame sizes and list prices of 448 electric motors.

L23. Generators—Allis-Chalmers Mfg. Co. Bulletin No. 1171, 12 pages, illustrating special d.c. generators, armature winding and accompanying switchboards.

L24. Variable-Speed Motors—U. S. Electrical Mfg. Co. Bulletin describes "Varidrive" motor with lever-arm construction.

L25. Gearmotors—Allis-Chalmers Mfg. Co. 4-page illustrated leaflet No. 2203 describes and shows applications for self-contained speed reducers, integral or attached motor.

L26. Synchronous Drives—General Electric Co. 4-page leaflet GEA-2177, shows Power Selsyns, self-synchronous apparatus.

L27. Shaftless Motors — Louis Allis Co. 8-page Bulletin No. 516 describes shaftless motors and their electrical characteristics.

L28. Gear Motors—Dominion Engineering Co., Ltd. Bulletin No. 129, 16 pages, illustrates and gives complete data, including dimensions and horsepower-ratio tables for line of gear motors.

Brushes

M1. Brushes—David Linzer & Sons, Inc. 64-page catalog announces Compo-Fibre brushes.

M2. Carbon Brushes — Ohio Carbon Co. 12508 Berea Road, Lakewood, O. Loose-leaf, pocket-size catalog on carbon brushes for general use, including mainly fractional-horsepower, d.c. and single-phase repulsion-induction a.c. motor brushes.

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THE COUPON TO GET BULLETINS YOU NEED. SEE PAGE

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M3. Brush Maintenance—Ohio Carbon Co. "The Brush Phase of Motor Maintenance," explains causes and cure of sparking, excessive wear of brushes, commutators and slip-rings.

M4. Brush Maintenance—Ohio Carbon Co. 64-page booklet by engineering staff treats brush problem under headings; commutation in d.c. machines, d.c. vs. a.c., a.c. machines, types of brushes, physical electrical characteristics of brushes, how to order brushes, installing carbon brushes, maintenance and manufacture of Ohio brushes.

M5.—Commutators — Ideal Commutator Dresser Co. 64-page catalog No. H535 lists commutation products, care and servicing of commutators and slip-rings, electrical data and definitions.

M6. Mica Cutter—Ideal Commutator Dresser Co. 4-page technical bulletin describes electrically-driven "Ideal" undercutter with micrometer gage.

Switch Gear, Fuses and Cutouts

M7, 8, 9. Switchgear — General Electric Co. 4-page GEA-1372-A on indoor disconnecting switches with silver-line pressure contacts for 5,000-volt service, 400 to 5,000 amp. on insulating bases, 400 to 1,200 amp. on compound insulators; also 2-page GEA-1585A on high-voltage magentic switches of the oil-immersed type for service under 2,200 to 6,000 volts; also 8-page GEA-1137B on indoor a.c. cubicle switchgear with manually or electrically operated breakers up to 15,000 volts and 2,000 amp.

M10. Switchgear—Roller-Smith Co. Catalog No. 8, on metal-clad switchgear, including control panel, open and inclosed deadfront equipment, cubicles, metal-clad gear, switch houses and special equipment of many kinds.

M11. Metal-Clad Assembled Switchgear—General Electric Co. 4-page bulletin GEK-86 describes metal-clad switchgear for office building or industrial plants.

M12, 13, 14, 15. Switches & Circuit Breakers—Westinghouse Electric & Mfg. Co. Catalog sections 29-150, Type AB-F "De-Ion" Flipon Circuit Breakers; 29-200, Type AB-1, Circuit Breakers; 36-160, Type KA Outdoor Disconnecting Switches; 37-150, Type W Rotary Switches.

M16. Disconnect Switches—Schweitzer & Conrad, Inc. Bulletin No. 22-A, four-page, gives dimensions and ratings for wire-type, multi-point contact, disconnecting switches.

M17. Disconnect Switches — Delta-Star Electric Co. Bulletin No. 35-B on ratings, dimensions and characteristics of hook-operated and group-operated disconnect switches, for rural-line service up to and including 34-5 kv.

M18, 19, 20, 21, 22, 23. Switches—General Electric Co. Bulletin GEA-841D, A.C. Magnetic Switch, Full-Voltage Starter for Induction Motors; -1565A, Magnetic Reversing Switch for A.C. Motors; -1522C, Manual, Full-Voltage Type A.C. or D.C., Motor-Starting Switches; -1631B and -1903 Universal Control and Transfer Switches, Type SB-1; -1901, Silver Contact Disconnect Switch.

M24. Knife Switches — General Electric Co. Bulletin No. GEA-2127, 4-page, dimensions and details of large size knife switches.

M25, 26, 27, 28, 29, 30. Circuit Breakers—General Electric Co. Bulletins GES-1166, A.C. and D.C. Switchgear; GEA-1601A, Oil-Blast Circuit Breakers, Type FK-44; -1699, Medium Size Breakers; -1972, Type FK-144A Breaker; -2050, Moderate Capacity Breaker, Type FK-43; -2165, 25,000-kva. Oil-Blast Breaker, Type FK-42.

M31. Circuit Breaker—General Electric Co. 8-page folder describing moderate-capacity, oil-blast, circuit breaker, Type FK-43.

M32. Circuit Breakers — I.T.E. Circuit Breaker Co. 4-page Bulletin No. 1035 illustrates construction, operation and applications for self-actuated reclosing circuit breakers.

M33. Small Circuit Breakers—I.T.E. Circuit Breaker Co. 6-page Bulletin 634, "Itelite," describes small thermal circuit breakers in capacities to protect wire from 15 to 600 amp., and voltages to 250 d.c., and 600 volts a.c.

M34, 35, 36, 37. Fuses & Cutouts—Westinghouse Electric & Mfg. Co. Catalog Sections 38-600, Single-Pole, 2,500 volts, Plug-Type Fuse Cutouts for outdoor mounting; 38-620, Type ES Primary Fuse Cutouts; 38-660, Type LT Standard Low-Temperature Fuse Links; 38-665, Type UT, Universal Fuse Links.

M39. Oil Fuse Cutouts—General Electric Co. Bulletin GEA-2030, describes pole-type and subway-type G.E. Oil fuse cutouts.

M40. Fuse Switches—General Electric Co. Bulletin GEA-2123, 4-page folder giving ratings for outdoor, drop-out fuse disconnecting switches.

M41. Fuses—Schweitzer & Conrad, Inc. Bulletin No. 200C, four-page, on high capacity Type C fuses.

M42. Fuse Links—General Electric Co. 4-page Bulletin No. 1994A on universal fuse links for expulsion-type cutouts.

Meters & Instruments

N1, 2, 3, 4, 5, 6, 7, 8, 9. Meters & Instruments—General Electric Co. Bulletin GEA-55D, Round Switchboard Instruments; -615D, 50-page catalog of Watthour Meters; -819C, Horizontal-Edgewise, Switchboard Instruments; -1061E, Strip-Chart Recording Instruments for A.C. and D.C.; -1093A, Watthour Meters for Switchboards; -1239B, 12 pages, and -2180, Small Panel Instruments; -1758A. Rectangular Switchboard Instruments; -1784, Type AP-9 Portable Instruments.

N10, 11, 12, 13, 14, 15, 16. Meters & Instruments—Westinghouse Electric & Mfg. Co. Catalog Sections 43-306, Exploring Coil and Thermocouple-Type Temperature Indicators; 43-343, Total Time Meter; 41-375, Cycle Counter; 43-415, Switchboard and Portable, Type A, Recording Instruments; 41-915, Type C High-Speed, Gravity Operation Target; 37-220, Type M Test Switch for instrument, meter and relay circuits; 43-350, Type G Shunts for switchboard and portable d.c. ammeters.

N17. Meters — Weston Electrical Instrument Corp. Circular No. A-500A illustrates Model 639 industrial analyzer for measuring current, voltage, power and power-factor.

N18, 19, 20, 21, 22, 23. Instruments—Westinghouse Electric & Mfg. Co. Catalog Sections 43-105, Type PY-5 A.C. Portable Instruments; 43-145, Type TA A.C. Industrial Analyzer; 43-320, Types DX, DY and DY-2 A.C., D.C., R.F. and Rectox-type Switchboard Instruments; 43-330, Construction Features of Type MX and NX, D.C. Miniature Panel Instrument; 43-344, D.C., R. F. and Rectox Type RX Miniature Rectangular Instruments and 43-346, A.C. Type MA and NA Miniature Instruments.

N24. K.V.A. Meter—Esterline-Angus Co. 4-page Bulletin No. 735 on K.V.A. meter.

N25. Temperature Indication — General Electric Co. Bulletin GEA-1075A describes temperature-indicating equipment for a.c. generators, motors and transformers.

N26. Insulating Testing Instruments—James G. Biddle Co. 32-page catalog 1400 on "Megger" testers.

N27. Instrument Transformers — Allis-Chalmers Mfg. Co. 36-page catalog No. 152 describes "Transformers for Instrument and Metering Service."

N28, 29, 30, 31.—Instrument Transformers—General Electric Co. Bulletins GEA-2114, Indoor Potential Transformers, 230 to 13,800 volts; -2115 and 6, Indoor Current Transformers for not over 5,000 volts; -2117 for no tover 7,500 volts; -2118 for not over 15,000 volts.

N32, 33, 34, 35, 36, 37. Instrument Transformers—Westinghouse & Mfg. Co. Catalog Sections 45-110, Type W, Indoor, Dry-type, Current Transformers for 1 to 23 KV.; 45-120, Indoor, Through-Type Current Transformers for relays and circuit-breaker-trip-coils; 45-150, Type WO, Outdoor, Dry-Type Current Transformers; 45-170, Oil-Insulated Current Transformers; 45-200, Potential Transformers; 45-300, Portable Current Transformers.

N38. Regulator—Allis-Chalmers Mfg. Co. 8-page leaflet No. 2204 describes Type BFR branch feeder regulators.

N39. Voltage Regulators—Simplex Corp. Bulletin No. 201, recent installations and voltage regulators for plants to 50,000 kw.

N40. Voltage Regulators — Westinghouse Electric & Mfg. Co. 20-page illustrated catalog section No. 31-230, data on vibrating-type voltage regulators for generators.

N41, 42, 43, 44, 45. Generator-Voltage Regulators—General Electric Co. Bulletins GEA-2066, Type GFA-4 for A.C. Generators and Synchronous Motors and Condensers; -2097, Vibrating Contact Type TA for A.C. Machines; -2101, Development and Use, Reprint from "G.E. Review"; -2104, Type GDA and Type GFA-4; -2150, Direct-Acting Type GDD for D.C. Machines.

N46. Synchronizer — Allis-Chalmers Mfg. Co. 4-page leaflet No. 2202, describing a synchronizing device for automatically paralleling a. c. generators.

Miscellaneous

P1. Electric Equipment—Allen-Bradley Co. Series of price sheets for revised catalogs on all types of electrical equipment.

P2. Electrical Devices—Struthers Dunn, Inc. Bulletin 292 describes relays, timing devices, electric counters, thermostats, electric pots and ladles.

P3, 4, 5, 6, 7, 8. General Electric—General Electric Co. 19-page GEA-897E, "Air-Cooled Transformers for Lighting and Power Service," 34-page GEA-1305C, with supplement, on Luminous Tube Transformers. 4-page leaflet, GEA-1488A, on MC-5 Air Circuit Breaker for Frequent Operation and Severe Duty, 2-page GEA-286D on Full-Bolted Electric Power Connectors, 8-page GEA-1358A on Control and Signal Transformers, 2-page GEA-2023 on Moderate-Duty, Moderate-priced Outdoor Group-operated Switch, Type TC.

P9. Mercury-Arc Rectifier—Allis-Chalmers Mfg. Co. 20-page Bulletin No. 1168 on Mercury-Arc Rectifiers for Power Concersion in Electrolytic Plants.

P10. Rectifiers—Allis-Chalmers Mfg. Co. Bulletin No. 1169, 12 pages, describing mercury-arc power rectifiers.

P11. Power Factor—Esterline-Angus Co. 4-page bulletin No. 934 discusses "Power, Power Factor and Profits," a study of plant of United-Carr Fastener Co.

P12, 13, 14, 15, 16, 17, 18, 19. Capacitors—Westinghouse Electric & Mfg. Co. Catalog Sections 49-055, general information on "Inerteen" Capacitors; 49-100, Type FP (Fireproof) units for 230 to 6,900 volts and 60 cycles; 49-105, Individual Capacitor Boric Acid Fuses; 49-120 Inclosed, Type FP, indoor units for 230, 460 and 575 volts; 49-125, Small, Rack-type Equipment for 230, 460 and 575 volts; 49-150, same as 49-125 but for 2.3, 4 and 4.6 kv.; 49-200, large Rack-Type Equipments for 230 to 6,900 volts; 49-225, High-Voltage, D.C. Capacitors.

P20, 21. Capacitors—General Electric Co. Bulletins GEA-2027, Small-Size Pyranol Capacitors for motors, etc.; -77H, 30 pages on "Improving Power-Factor for Profits".

P23. Condensers—Aerovox Corp. 24 pages engineering data on electrolytic and oil-filled industrial condensers for motor-starting, power-factor correction, etc. 28-page manual and catalog.

P24, 25. Relays—General Electric Co. Bulletin GEA-1959A on Vacuum-Contact Relays and -2209, on Type TB-2, Bearing-Temperature Relays.

P26, 27, 28, 29, 30, 31, 32, 33, 34. Relays—Westinghouse Electric & Mfg. Co. Catalog Sections 37-280, D.C. Control Relays; 41-325, Types MA, ML, and MX Auxiliary Relays for A.C. or D.C.; 41-350, Type SG Auxiliary Relays for two independent A.C. or D.C. circuits; 41-410, Type Hy, High-Speed Impedance-Reactance Relay; 41-416, Type HZ-1, High-Speed Impedance Relays; 41-420, Type HCZ Impedance Relay; 41-475, Type SC, SC-1 and SC-2 Current Relays and SV, SV-1 and SV-2 Voltage Relays; 4-480, Type SM Instantaneous Overcurrent Relay; 41-820, Type HQ Thermostatic Relays.

P35. Relays—General Electric Co. Bulletin GEA-1867, 12 pages, polyphase power-directional relays.

P36. Relays—Weston Electrical Instrument Corp. 12-page "Weston Relays," describing sensitive toggle, polarized, power and time-delay relays.

P37. Transformers — Allis-Chalmers Mfg. Co. 8-page Bulletin No. 1173 shows exterior and cutaway interior views of distribution transformers.

P38, 39. Transformers—General Electric Co. 8-page Bulletin No. 1173 shows distribution transformers.

P40. Auto Transformer — Allis-Chalmers Mfg. Co. Single-sheet leaflet No. 2185 on transformers for reducing light flicker.

P41. Small Transformers—General Elec-

tric Co. 8-page Bulletin No. GEA-1358B on transformers for control and signal circuits.

P42. Cable—General Electric Co. 28-page Bulletin No. GEA-1278B describes paper insulated cable.

P43, 44. Industrial Cable—General Electric Co. Bulletin GEA-1837, an 80-page publication on how to select insulated cable. GEA-1838 "Industrial Cable, 128 pages, describes all standard types of insulated wire and cable except paper-insulated types.

P45, 46, 47, 48, 49, 50, 51, 52, 53. Cable—General Electric Co. Bulletins GEA-1746A, Glyptal, Treated-Cloth Cable Insulation; -1774A, Rubber- and Rubber-Like Insulated Armored Cable; -1788A, Coronal, High-Voltage, Cable-Insulating Compound; -2103, Weatherproof Line Wire; -2110A, Versatol, Cable-Insulating Compound; -2111, Tellurium Compound, Jacket on Portable Cable; -2113, Cable Compounds for Insulating and Sheathing Cable; -2192, Types of Insulated Cable; -2246, Portable Cable.

P54. Cable Accessories—General Electric Co. Bulletin No. GEA-1839, 80-page catalog gives data on cable accessories.

P55, 56. Low-Voltage Cable — General Eelectric Co. 4-page GEA-1885 on Low-Voltage Secondary Cable for Networks and GEA-1662A, 4 pages, on Trip-Free Air Circuit Breakers.

P57. Conduit—Johns-Manville, 18-page illustrated folder, DS Series 410 on Transite electric conduit.

P58. Distribution Panelboards—Westinghouse Electric & Mfg. Co. 4-page catalog section 29-450, descriptive data on "No-fuze" convertible distribution panelboards.

P59. Switchboard Panels — Westinghouse Electric & Mfg. Co. single-sheet catalog section 37-240 on steel switchboard panels.

P60. Terminal Blocks — Westinghouse Electric & Mfg. Co. single-sheet catalog section 37-260 illustrates terminal blocks.

P61. Outdoor Terminal Boxes—W. T. Henley's Telegraph Works Co., Ltd. Catalog UE 5 describes terminal boxes.

P62, 63. Lightning Arresters — General Electric Co. 12-page Bulletin GEA-1340C on Thyrite, Form D, Lightning Arresters. Also 9-page Bulletin GEA-1993 on inclosed indicating and drop-out fuse cutout.

P64, 65, 66. Arrester—Westinghouse Electric & Mfg. Co. Catalog Sections 38-180 on Type RV Signal Arrester, 38-175 on Watthour-Meter-Protectors and 38-260 on D.C. Lightning Arrester.

P67. Starters—Allen-Bradley Co. Cut-out bulletin No. 709 on automatic starters.

P68. Starters—Lincoln Electric Co. Two single sheets illustrate and describe automatic motor starters.

P69, 70. Contactors—General Electric Co. Bulletins GEA-2226 and 7 on D.C. Contactors for 600 volts, 150 to 2,500 amp.; GEA-2228 on Size O Multiple Contactor for 15 amp., 600 volts.

P71. Lamps—Wabash Appliance Corp. 24-page Catalog No. 703 on lamps.

P72. Megger—James G. Biddle Co. 128-page pocket manual of "Megger" practice.

P73. Solenoids—General Electric Co. Bulletin GEA-2080, single sheet on a.c. and d.c. solenoids, CR9503.

P74. Resistors—Ohio Carbon Co. Folder describing low-resistance carbon resistors for increasing sensitivity range of electronic control apparatus.

P75, 76. Photo-Electric Equipment—Westinghouse Electric & Mfg. Co. Catalog Section 43-950, 8 pages, on Type LE photoelectric relays. Catalog Section 43-960, 4 pages, on Type S Light Source.

PIPING, VALVES AND FITTINGS

Q1.—Pipes—A. M. Byers Co. Two bulletins: No. 52 on "Theory and Practice of Threading Genuine Wrought Iron Pipe"; No. 50 on "Principles and Practice of Bending Wrought Iron Pipe."

Q3. Pipes—Republic Steel Corp. 16-page folder "The Greatest Pipe Show on Earth" describes tubular products.

Q4. Steam Conduits—H. W. Porter & Co. 8-page Bulletin No. 352 contains specifications for steam conduits.

Q5. Steam Distribution — American District Steam Co. Addition to general catalog gives information on entire line.

Q6. Conduit System—H. H. Porter & Co. Bulletin No. 351. 8-page folder showing system of protection and insulation for underground pipe-lines.

Q7. Tile Conduit—RicWil Co. Bulletin describes "Superstrength" heavy tile conduit for underground steam lines.

Q8. Pipe Fittings—Taylor Forge & Pipe Works. Three pages, important revisions in Catalog 34-1, covering seamless steel fittings for welding.

Q9. Pipe Coupling—S. R. Dresser Mfg. Co. Bulletin describes Style 65 compression coupling uses plain-end pipe which makes joint and ordinary wrench.

Q10. Pipe Hangers—Grinnell Co. Bulletin No. A-12 on Grinnell "Genspring" constant support hangers for floating pipelines.

Q11. Pipe Joints—S. R. Dresser Mfg. Co. 16-page booklet No. 355 general information on pipeline products.

Q12. Expansion Joints — Direct Separator Co., Inc. 22-page loose-leaf catalog No. EJ-35, on internally and externally guided expansion joints.

Q13. Expansion Loops—Tube-Turns, Inc. Quick reference chart for designing expansion loops, using Tube-Turns and straight lengths of pipe or tubing.

Q14. Pipe Flanges—Taylor Forge & Pipe Works. 96-page catalog 35, "Forged Steel Pipe Flanges" includes prices and dimensions and fittings for welding.

Q15. Tube-Fabricating Equipment—Parker Appliance Co. 24-page Bulletin No. 40 describes tube-fabricating equipment.

Q16. Tubing Weight Tables—Timken Steel & Tube Co. 12-page "Master Weight Tables" tabulate weights of hot- and cold-finished tubing from $\frac{1}{16}$ in. up to $10\frac{3}{4}$ in., and from wall thickness 36 B.G.W. to $1\frac{5}{8}$ in.

Q17. Blast Gates—W. S. Rockwell Co. Single-sheet Catalog No. 355, gives information on butterfly-type blast gates.

Q18. Floats—W. H. Nicholson & Co. 4-page bulletin No. 635 details series of welded -steel (chromium-plated) and welded stainless steel floats.

Q19. Steam Traps—W. H. Nicholson & Co. 4-page folder on industrial steam traps.

Q20. Steam Trap—D. G. C. Trap & Valve Co., Inc. 4-page bulletin describes "Cryer Inverted-Bucket Steam Trap."

Q21. Steam Trap—W. H. Nicholson & Co. Bulletin No. 535 on traps with union connections for use on radiators and unit heaters where reduced pressure steam is used.

Q22. Traps—Hoffman Specialty Co., Inc. 12-page cut-away bulletin illustrates No. 8A thermostatic trap. Also other streamline equipment.

Q23. Valves—Wm. Powell Co. Line of bronze valves for connection to Muller Brass Co.'s copper pipe and tubing.

Q24. Valves—Homestead Valve Mfg. Co. Folder describes plug, poppet-type and seat and disk valves.

Q25, 26 Valves—Hancock Valve Division, Consolidated Ashcroft Hancock Co., Inc. Two bulletins No. 7009-A, on "Flocontrol" valves manually operated. Other is 8-page bulletin on union bonnet bronze valves.

Q27. Valves—Edward Valve & Mfg. Co., Inc. Catalog No. 11-G4 describes forged-steel specialities, including gage and straight-through valves, strainers, relief valves, special valves for turbine oil lines, small forged-steel stop-check valves.

Q28. Valves—Homestead Valve Mfg. Co. 46-page reference book No. 37 describes valves, vapor-spray cleaning machines.

Q29. Valves—Parker Appliance Co. 60-page booklet No. 38 covers valves, specifications and price lists, lists on more common standard types. Also 32 new dimension sheets of engineering data and two new bulletins on tube fabrication.

Q30. Valves—Fairbanks Co. 56-page catalog contains 96 illustrations of valves and data on unions.

Q31. Valves, Etc.—Kieley & Mueller, Inc. 164-page Catalog No. 57 (revised) covers steam, water, air, gas and oil specialties.

Q32. Valve Chart — Merco Nordstrom Valve Co. Service chart describing, under headings "Operation," "Adjustment," "Lubrication" and "Repair," proper care for Nordstrom lubricated plug valves.

Q33, 34. Valve Specialties—Davis Regulator Co. Two 32-page illustrated bulletins, No. 100 on pressure regulators, governors and strainers, and No. 101 on fluid-level controllers, numerous types of valves, traps and air vents.

Q35. Valve Reconditioning—Edward Valve & Mfg. Co. Monthly "Valve Values" discusses reconditioning of valves and gives other information.

Q36. Blowoff Valve—Yarnall-Waring Co. Bulletin B-149 describes forged-steel tandam-blowoff valves for 600 and 1,500 lb.

Q37. Blowoff Valves—Yarnall-Waring Co. Bulletin No. B-419 on forged steel, hard-seat blowoff valves for two pressure ranges, 600 and 1,500 lb.

Q38. Diaphragm Valves—C. J. Tagliabue Mfg. Co. Buleltin No. 1117 describes diaphragm valves with new long-range throttling top.

Q39. Fluid Valves—Westinghouse Electric & Mfg. Co. Catalog Section 235-183, 4 pages, illustrated, on fluid valves for d.c. and a.c. applications.

Q40. Gas Valves—Minneapolis-Honeywell Regulator Co. Bulletin No. 7-306 on motor or manually-operated slow-opening gas valves in sizes from $1\frac{1}{2}$ to 6 in.

Q41. Gate Valves—The Lunkenheimer Co. 8-page bulletin, "For Corrosive Service—Lunkenheimer 'Causul' Metal Gate Valves, With Alloy Trim."

Q42. Renewable Gate Valves—Fairbanks Co. Bulletin on renewable gate valves.

Q43. Lift-Type Valves—Homestead Valve Mfg. Co. Reference Book No. 37 describes line of cast-steel lift-type valves in sizes from $1\frac{1}{2}$ to 12 in. Made in straight-way, 3-way and 4-way for pressures to 1,500 lb.

Q44. Lubricated Plug Valves — Merco-Nordstrom Valve Co. 32-page bulletin describes lubricants for plug valves.

Q4. Vacuum Dial—Hoffman Specialty Co., Inc. Bulletin describes radiator vacuum valve, also float and thermostatic traps and supply valves.

STEAM, OIL AND GAS PRIME MOVERS AND AUXILIARIES

R1. Steam Turbines—Elliott Co. 4-page bulletin describes Types AY and BY mechanical-drive turbines.

R2. Steam Turbines—California Bettis Co. Bulletin describes auxiliary steam turbine for services up to $3\frac{1}{2}$ hp.

R3, 4, 5. Mechanical-Drive Turbines — General Electric Co. Three bulletins describe mechanical-drive turbines, as follows: Bulletin GEA-1450B, Single-Stage Steam Turbines, 40 to 400 hp., Non-Condensing; Bulletin GEA-2044, Multistage Steam Turbines 100 to 2,000 hp., Condensing or Non-Condensing, Oil Relay Governor. Bulletin GEA-2024A, Multistage Steam Turbines 100 to 2,000 hp., Condensing and Non-Condensing Steam-Extraction Multiport Valve Gear.

R6. Turbines—General Electric Co. Bulletin GEA-1257C on Type D-57 single-stage turbines for mechanical drive up to 125 hp., non-condensing.

R7. Turbines—De Laval Steam Turbine Co. 4-page reprint of article from "Nautical Gazete," on use of geared turbines on "S.S.G. Harrison Smith."

R8. Turbine Blading—International Nickel Co., Inc. Fall Edition, 1934, of "INCO." Vol. XII, No. 3.

R9. Steam Engines—Elliott Co., Pittsburgh, Pa. 32-page bulletin B-3 describes single-valve, 4-valve, Corliss-valve unaflow, poppet-valve unaflow.

R10. Diesel Engines—Busch-Sulzer Bros.-Diesel Engine Co. 24-page bulletin No. 837-B on DF and DB 4-cycle trunk-piston, mechanical-injection, diesels.

R11. Diesel Engines—Caterpillar Tractor Co. 14-page Bulletin No. 2984, answers questions, "Why the Diesel?", "How Does the Diesel Run?" "What Do Owners Think?"

R12. Diesels—Caterpillar Tractor Co. Five folders covering the application of diesel power units to a wide variety of installations including diesel-electric sets.

R13. Diesel Engines—Chicago Pneumatic Tool Co. Bulletin No. 779 describes 4-cycle direct-injection, pressure-lubricated full diesel which may be converted to gas.

R14. Diesel Engines — Cooper-Bessemer Corp. 12-page folder describes 25 to 110-b.hp. single- and twin-cylinder horizontals.

R15. Diesel Engines—Ingersoll-Rand Co. 20-page catalog discussing 4-cycle, single-acting, diesels, 175 to 1,500 b.hp.

R16. Diesel Engines—Worthington Pump & Machinery Co. 16-page Bulletin S-500-B6D, "Worthington Diesel Engines Vertical 4-Cycle Direct-Injection, Types B, C, D, E," gives specific information on engines from 25 to 1,000 hp. and 1 to 8 cyl.

R17, 18. Diesel Fuel—Two bulletins of Caterpillar Tractor Co. "Fuels for the Caterpillar Diesel," and Issue No. 100 of "The Dotted Line," titled "What Oil Companies Say About Diesel Fuels."

R19. Diesel Pumps—Viking Pump Co. 4-page bulletin No. 2200-35.

R20, 21. Diesel Fuel Pumps—Ex-Cell-O Aircraft & Tool Co. Folder No. OG-9022 or

Manual No. 12 on fuel-injection pump, Model 8, for diesels up to 200 hp., for 26 to 260 cu.in. piston displacement.

R22. Diesel Purifier—Goulds Pumps, Inc. 6-page Bulletin No. 501 describes "Hydroil Centrifugal Purifiers" for purifying diesels.

R23. Gas Engines—Meriam Co. Series of monthly post cards on gas engine data.

R24. Gas Engines—Worthington Pump & Machinery Corp. 6-page Bulletin S-550-B6 on Vertical Four-Cycle Type CG Engines.

R25. Gas Engines—Worthington Pump & Machinery Corp. Bulletin, "Worthington Gas Engines, Vertical Four-Cycle, Types BG, CG, DG and EG."

R26. Rebuilt Gas Engines — Meriam Co. Operating instructions on oil and lubrication data for this company's rebuilt gas engines, as well as others. Prepared jointly by this company and Socony-Vacuum.

R27. Cooling Towers — Binks Mfg. Co. Bulletins describe induced-draft cooling towers from 5 to 200 g.p.m.

R28. Piston Rings—American Hammered Piston Ring Co. 156-page handbook gives recommended types, specifications and applications of piston rings.

R29. Oil—Acheson Colloids Corp. 3-page technical bulletin No. 40.1 deals with crankcase analyses and deductions on sludge.

PUMPS FOR POWER PLANT AND INDUSTRIAL USES

S1. Centrifugal Pumps — Allis-Chalmers Mfg. Co. 48-page bulletin No. 1651 covers types and applications.

S2. Centrifugal Pumps — Gardner-Denver Co. Bulletin No. CP11 on Types B and C side-suction centrifugal pumps with capacities to 500,000 g.p.h. or 450 g.p.m. at heads to 100 ft.

S3. Centrifugal Pump — Gardner-Denver Co. Bulletin on double-suction centrifugal pump for general water supply, etc.

S4. Centrifugal Pumps—Lawrence Pump & Engine Co. 4-page folder D15 describes contrifugals in two, four and six stages for heads to 1,200 ft.

S5. Pumps—Lawrence Pump & Engine Co. 8-page bulletin describes "Electropump" centrifugal pumping units.

S6. Centrifugal Pumps—Lawrence Pump & Engine Co. Bulletin No. P-17 describes "Black Arrow" single-stage centrifugal pumps in sizes from 2 to 14 in. for capacities 30 to 10,000 g.p.m., heads to 300 ft.

S7. Pumps—Morris Machine Works. Bulletin No. 157, 16 pages, reference work on centrifugal pumps.

S8. Pumps — Roots-Connersville Blower Corp. Bulletin No. 260-B12 on Type "T" turbine pump for volatile liquids.

S9, 10, 11. Centrifugal Pumps—Worthington Pump & Machinery Co. Three new bulletins: Worthington Monobloc Centrifugal Pumps, Types DE, DF and DG, described in 4-page bulletin W-321-B4. Also 4-page Bulletin W-318-B4 on Worthington 3-Stage Volute Centrifugal Pumps, Type UC, and 4-page Bulletin W-321-B3 on Monobloc Centrifugal Pumps.

S12. Pumps — Worthington Pump & Machinery Corp. Bulletin No. W-321-B2A on small-size centrifugal pumps.

S13. Centrifugal Pumps — Worthington Pump & Machinery Corp. 4-page bulletin single-stage volute pumps, Type L.

S14. Centrifugal Pumps — Worthington Pump & Machinery Corp. 6-page Bulletin W-310-B4A on Types C, CA and CB centrifugal pumps.

S15. Centrifugal Pumps — Worthington Pump & Machinery Corp. Bulletin, "Worthington Centrifugal Pumps, Single-Stage Volute, Types LA and LC," 4 pages.

S16. Centrifugal Pumps — Worthington Pump & Machinery Corp. Bulletin W-321-B7 describes open-impeller "non-clogging" pump for solid materials in suspension.

S17. Centrifugal Pumps — Worthington Pump & Machinery Corp. Bulletin W-323-B3 describing automatic self-priming "Monobloc" centrifugal pump.

S18. Pumps—American Engineering Co. 44-page catalog gives charts, tables, drawings, data and uses for pumps, hydraulic motors, transmissions, regulators, differential valves and pipe-testing machines.

S19, 20, 21, 22, 23, 24. Pumps—DeLaval Steam Turbine Co. Six bulletins: Catalog B-21, 22, 24, and 25 on single-stage double suction pumps; Catalog B-23 on single-stage single-suction pumps; Catalog E-1166 on centrifugal pumps, and 8-page reprint from "Combustion" on centrifugal boiler-feed pumps for high pressures, by A. Petersen.

S25. Pumps—Lawrence Machine & Pump Corp. Bulletin No. 204 describes high-duty multi-stage pumps for waterworks, boiler plants, etc.

S26. Pumps—Lawrence Machine & Pump Corp. Bulletin No. 201 describes double-suction, horizontally split pumps.

S27. Pumps—Lawrence Machine & Pump Corp. Bulletin No. 203 illustrates acid and chemical pumps.

S28. Pumps—Lawrence Machine & Pump Corp. 4-page Bulletin No. 206 covering sewage and sludge pumps.

S29. Pumps—Lawrence Machine & Pump Corp. 4-page Bulletin No. 208, covers standard dredging pumps for ashes and cinders.

S30. Pumps—Nash Engineering Co. 35-page Bulletin No. 236 on pumps, ejectors.

S31. Pumps — Quimby Pump Co. 4-page Bulletin No. R-200, illustrates, gives specifications and ratings for "Rotex" pumps.

S32. Pumps — Viking Pump Co. 52-page catalog No. 35-G describes line of pumps.

S33. Pumps—Worthington Pump & Machinery Corp. Four 4-page leaflets on centrifugal, horizontal-duplex piston and sump pumps and air-lift pumping systems.

S34. Pumps—Worthington Pump & Machinery Corp. 8-page booklet covers deep-well turbine pumps.

S35. Pumps—Worthington Pump & Machinery Corp. Bulletin No. W-102-B1, 6-page, horizontal-duplex piston pumps.

S36. Pumps — Worthington Pump & Machinery Corp. Bulletin No. W-316-B3, 8 pages, line of vertical drainage pumps.

S37, 38. Pumps—Worthington Pump & Machinery Corp. Two bulletins, No. W-102-B1, on horizontal-duplex piston-pumps, No. W-312-B1A on single-stage volute Type LT centrifugal pumps for pumping hot and volatile liquids at temperatures to 600 deg. F.

S39. Pumps—Worthington Pump & Machinery Corp. Bulletin W-450-B24, "Deep-Well Turbine Pumps."

S40. Pumps—Worthington Pump & Machinery Corp. Bulletin No. L-700-B1 describes double-acting, single, vertical, high-vacuum pump in one or two stages.

S41. Special Pumps—Allen-Sherman-Hoff Co. 24-page Catalog No. 735-A describes Hydroseal sand pump and Maximix acid-resisting pump.

S42. Power Pump—Worthington Pump & Machinery Corp. Mimeographed sheets describe totally-inclosed frame power pump.

S43. Vacuum Pumps — Root-Connersville Blower Corp. 4-page Bulletin 50-B11 describes vacuum pumps for high-duty use.

S44. Lift Pumps—Byron-Jackson Co. Bulletin on "Hydropress" centrifugal pumps for pressures to 2,800 lb., 10 to 250 g.p.m.

S45. Piston Pumps—Worthington Pump & Machinery Co. Bulletin No. Q-110-B2 describes line of liquid and side-pot piston pumps for pressures to 700 lb. per sq.in.

S46. Motor Pump — Fairbanks, Morse & Co. Bulletin No. 5550 describes "built together' motorpump for 10 to 250 g.p.m., with heads to 190 ft.

S47. Pumping Unit—Allis-Chalmers Mfg. Co. 4-page leaflet No. 2199 gives details of Type "SSU" pumping unit.

S48. Rotary Pumps—Worthington Pump & Machinery Corp. Bulletin W.475-B8 describes steam-jacketed rotary pump.

S49. Fire Pumps—Worthington Pump & Machinery Corp. Bulletin No. W-320-B1 describes centrifugal fire pumps, Group LG single-stage, volute type, direct-connected.

S50. Pumping System—Ingersoll-Rand Co. 24-page Bulletin No. 9042 describing method of air-lift pumping of water, oil, etc.

S51. Condensation Unit—American Steam Pump Co. 4-page bulletin No. 426 describes single and twin units, "Redi-Return," centrifugal, motor-driven, to handle condensate.

S52. Condensate-Return Unit—Worthington Pump & Machinery Corp. Bulletin No. W-321-B6 describes 54 sizes and types of automatic "Monobloc" condensate-return.

REGULATORS AND CONTROLLERS

T1. Controllers—Brown Instrument Co. 24-page Catalog No. 8900 describes air-operated controllers for temperature, pressure, flow and liquid level.

T2. Controllers—A. W. Cash Co. Bulletin No. 963 on Type 100 series controllers for governing flow of water, oil or air.

T3. Controllers—Foxboro Co. Bulletin No. 202 on potentiometer and resistance thermometer controllers.

T4. Stoker Control—Mercoid Corp. Bulletin No. 241 on stoker control system.

T5. Controller—C. J. Tagliabue Mfg. Co. Bulletin No. 1127 describes No. 40 controller for automatic control applications.

T6. Control Systems—Taylor Instrument Co. Bulletin 37R, 36 pages, describes operation, accessories and applications for control systems.

T7 and 8. Thrustors—General Electric Co. Booklet GET-459A on "Application of Thrustors" and GEA-1614A, Construction and Operation of Thrustors.

T9. Pressure Control—Minneapolis-Honeywell Regulator Co. Bulletin No. 5-311 describes static pressure control for accurate control of low pressures to 1 in. water.

T10. Pressure and Release Control—Penberthy Injector Co. Bulletin on Model A and Model B pressure and release control for keeping hot-water systems filled with water and relieving excess pressure automatically.

T11. Temperature Controls.—Edison Electrical Controls Division, Thomas A. Edison, Inc. Catalog M6-D8 on temperature-control device for watercooled internal-combustion engines.

T12. Thermostat Control—General Electric Co. Bulletin GEA-1767A, single sheet on thermostat control panels.

T13, 14. Time Control—Automatic Temperature Control Co. Bulletin No. CRD and Catalog TC describe series No. 1274-5-6 time-control units which repeat one or two operations or processes as often as desired.

T15. Regulators — Fisher Governor Co. 76-page Catalog No. 32-A covers automatic controls for gas industry.

T16. Regulators—Smoot Engineering Div., Republic Flowmeters Co. 24-page "Smoot Regulators," Catalog No. S-10.

T17. Regulators — Smoot Engineering Division, Republic Flow Meters Co. Data Book No. S-11, 32-pages, describes Series "50" (hydraulic) and Series "60" (pneumatic) regulators.

T18. Gas Regulators—Chaplin-Fulton Mfg. Co. 1935 catalog, 76 pages on Fulton gas regulator with automatic cutoff for natural gas, and Fulton duplex gas governor.

T19. Gas Regulation—Chaplin-Fulton Mfg. Co. Catalog describes gas regulators, gas-fuel supply and steam-pressure control.

T20. Feedwater Regulators—Bailey Meter Co. 16-page "Bailey Feedwater Regulators," No. 83, thermal hydraulic regulators.

T21. Feedwater Regulators—Stets Co., Inc. Feedwater regulator booklet.

MISCELLANEOUS EQUIPMENT

Materials

U1. Bakelite — Bakelite Corp. 39-page booklet, "Bakelite Varnish Enamel, Lacquer and Cement Heat Hardenable" for central station armature impregnation.

U2. Bakelite—Bakelite Corp. 40-page, profusely illustrated, two-color booklet traces 25-year history of company.

U3. Bakelite — Synthane Corp. 6-page folder describing and illustrating use for mechanical applications.

U4. Celite—Johns-Manville. 24-page booklet No. FA-7A details history and uses of Celite. Four sections devoted to high-temperature insulation, filter aid, mineral filler, and workability agent in concrete. Appendix contains technical data.

U5. Repair Cement—Smooth-On Mfg. Co. Booklet, Home and Auto Repairs," describes applications of Smooth-On.

U6. Cork Insulation—Cork Insulation Co., Inc. Bulletin 341 describes Corinco isolation corkboard for noise and vibration.

U7. Forgings—Kropp Forge Co. 4-page bulletin, "Forging the Impossible," pictures striking difficult jobs.

U8. Friction Materials — Johns-Manville. 8-page Bulletin No. FM-4A, industrial friction materials. Two tables.

U9. Friction Materials — Johns-Manville. 12-page folder FM-5A, "Masters of Mo-

tion." Gives research on friction materials.

U10. Insulation—Johns-Manville. 48-page Catalog No. GI-4A illustrates application of insulation, packing, refractories, roofing and siding, flooring, friction materials, electrical materials, transite pipe, etc.

U11, 12, 13. Monel Metal—International Nickel Co., Inc. Three bulletins, H1, "Monel Metal in Pumps," T-9, "Engineering Properties of K Monel," and 8-page folder illustrating applications.

U14. Perforated Metals—Manhattan Perforated Metal Co., Inc. Bulletin, "Perforated Metals," specifies perforation patterns and sizes of sheets furnished in brass, copper, Monel, steel and other metals.

U15. Porous Materials—Norton Co. 20-page Bulletin No. 1246 on line of porous plate and tubes.

U16. Resurfacer—Flexrock Co. One-page folder on "Ruggedwear Resurfacer."

U17. Synthetic Rubber—B. F. Goodrich Co. 12-page Bulletin No. 1050 describes "Koroseal" synthetic rubber-like material.

U18. Rubber-Covering — Self-Vulcanizing Rubber Co. Bulletin on "Self-Vulc" rubber covering in liquid or plastic form.

U19. Nickel Cast Iron — International Nickel Co., Inc. 12-page bulletin on nickel-alloy cast irons.

U20. Sheet Iron—Republic Steel Corp. 8-page No. ADV-132, "Thumbs Down on Rust," gives reasons for high rust resistance of Toncan copper-molybdenum iron.

U21. Sheet Iron—Republic Steel Corp. 65-page booklet, "Sheet Iron—A primer," tells story of sheet manufacture, discusses corrosion-resisting alloys.

U22. Wrought Iron—A. M. Byers Co. 12-page reprint from "Boiler Maker and Plate Fabricator," gives principles and practice used in employing bent wrought-iron plates.

U23, 24. Wrought Iron—A. M. Byers Co. Two reports by Engineering Service Department on use of wrought iron for (1) refrigeration systems and (2) flue-gas conductors and coal-handling equipment.

U25. Wrought Iron—A. M. Byers Co. 16 pages on "Wrought Iron in Industry."

U26. Steel—Timken Steel & Tube Co. 6 sheets, supplement to "Digest of Steels for High-Temperature Service." Contains data on "Sicromo Steel.'

U27. Steel—Republic Steel Co. 4-page folder gives S.A.E. steel specifications.

U28. Steel — Lukens Steel Co. 16-page leaflet traces 125-year history of company.

U29—Alloy Steels—Bethlehem Steel Co. 16-page Bulletin No. 88 contains physical property charts for seven alloy steels.

U30. Alloy-Steel Boiler Plate—Lukens Steel Co. Bulletin "Specification for Chrome - Manganese - Silicon Alloy Steel Boiler Plate," is reprint from A.S.M.E. Boiler Construction Code.

U31. Steel Applications—Republic Steel Corp. 12-page rotogravure tabloid showing exhibits at Century of Progress Exposition in which Republic products were used.

U32. Floor Grating — Arrowhead Iron Works. 16-page catalog, "Arrowhead Grating," steel grating for floors.

U33. Steel Floor Grids—Hendrick Mfg. Co. 20-page booklet, "Mitco Products," describes open steel floorings, special treads and Armorgrids, for power plants.

U34. Steel Forgings—Kropp Forge Co. 4-page bulletin, "Heat-Treated Forgings."

U35. Steel Length Multiples—Timken Steel & Tube Co. Six sheets of tables punched for standard 3-ring binders, entitled "Multiples At a Glance," gives ten tables for steel users.

U36. Steel and Products—Lukens Steel Co. 8-page booklet, "World's Largest Plate Mill and Its Products," summarizes work of Lukens, Byproducts Steel Corp., Lukenweld.

U37. Rolled Steel—Illinois Steel Co. and Carnegie Steel Co. have collaborated in 16-page technical booklet on rolled steel for machine construction.

U38. Sectional Steel—Bethlehem Steel Co. Booklet No. 78, "Bethlehem Light Sections," covers light-section beams, joists, etc.

U39. Stainless Steel—Crucible Steel Co. of America. 82-page Section 3 of catalog, "Corrosion and Heat-Resisting Steels."

U40. Stainless Steel—Republic Steel Corp. 16-page Booklet 125-A, latest data on various Enduro 18-8 stainless steels. Table showing corrosion resistance of three types.

Paint & Equipment

U41. Paint—Bakelite Corp. 24-page booklet, "Bakelite Synthetic Resins for Paints and Varnishes.

U42. Air Nozzles—Lunkemheimer Co., Cincinnati, Ohio. 4-page folder on bronze air nozzles with renewable non-metallic disk.

U42. Light Products — Pittsburgh Plate Glass Co. 32-page bulletin gives quantitative and qualitative discussion on light.

U43. Spray Nozzles—Binks Mfg. Co. Bulletin No. 50. 8-page, booklet for applications of spray nozzles.

U44. Spray Equipment—Binks Mfg. Co. 32-page bulletin AD 114 spray-gun equipt.

Coal & Ash Handling

U45. Ash Conveyor—Girtanner Conveyors & Engineering Co. 8-page bulletin, "Speedeveyor Steam-Actuated Pneumatic Ash Conveyor."

U46. Grab Bucket—Westinghouse Electric & Mfg. Co. Release A-63888 describes motor-driven grab bucket, capacities ½ to 3 cu. yd. for coal and ash.

U47. Bucket Elevators—Jeffrey Mfg. Co. 111-page catalog "Bucket Elevators Standardized Equipment for General Services."

U48. Coal and Oil-Handling Equipment—C. O. Bartlett & Snow Co. 48-page Bulletin 73 gives layout drawings for coal- and ash-handling equipment for industrial plant.

U49. Conveyors—Jeffrey Mfg. Co. 112-page Catalog No. 610 lists standardized belt conveyors and accessories.

U50. Conveyors—Chain Belt Co. 28-page folder shows various types of materials-handling equipment and application.

U51. Conveyors—Palmer-Bee Co. 64-page Section 107 of General Catalog 100 gives data on screw or spiral conveyor machinery.

U52. Conveyors—Link-Belt Co. Folder No. 1414, covering portable belt conveyors.

U53. Conveyor Idler—Link-Belt Co. Folder No. 1408 on "Positive" self-aligning anti-friction idler for troughed conveyor belts.

U54. Cranes—Cleveland Crane Eng. Co. 6 page bulletin illustrates tramrail and transfer bridges for industrial applications.

U55. Cranes—Whiting Co. 4-page Bulletin 195 on "L-H" and "LHE" traveling cranes, either hand- or electro-powered.

U56. Tanks and Industrial Equipment—L. O. Koven & Brother, Inc. 52-page catalog outlining services to industrial fields.

Tools

V1, 2. Abrasives — Norton Co. 28-page bulletin, "Abrasives, Their History and Development." Also 8-page bulletin, "Norton Bortz (Diamond) Wheels."

V3. Industrial Cleaner—Ideal Commutator Dresser Co. Bulletin describes industrial cleaner for vacuum cleaning, blowing.

V4. Tube Cleaner—Roto Co. Bulletin describes air-driven cleaner for small tubes.

V5. Cutting Machine—A. C. Campbell, Inc. Folder describing Model 302 horizontal wet-abrasive cutting machine.

V6. Grinding Wheels—Norton Co. Bulletin, "Grinding Wheel information and Selection.' 59 pages.

V7. Tools—Bonney Forge & Tool Works. Catalog No. 35. 48-pages, wrenches, tools.

V8. Tools—Skilsaw, Inc. Catalog No. 36, 34 pages, covers portable electric tools.

V9. Pneumatic Wrench — Ingersoll-Rand Co. Pamphlet No. 2152 describes "Pott" impact pneumatic wrenches.

Gaskets, Packing, Etc.

V10. Gaskets—Goetze Gasket & Packing Co. 64-page Catalog No. 48 on metallic and semi-metallic gaskets, sheet and stuffing box packings, sealing compounds, tools.

V11. Leather Packing—Alexander Brothers, Inc. 24-page handbook No. A-49 is condensed leather packing catalog.

V12, 13, 14. Packings—Belmont Packing & Rubber Co. Three separate folders describe packings for oil and gasoline, steam and water service.

V15. Packing and Accessories—Greene, Tweed & Co. Catalog No. 16 of Mill Supplies and Contractors' Specialties, lists data on packing belts and fasteners, gasket tubing, soft hammers, leather, lubricants, wrenches, etc.

V17. Rubber Goods—B. F. Goodrich Co. 23-page booklet catalogs variety of rubber goods, including belting, hose, packing.

V18. Rubber Goods—Manhattan Rubber Mfg. Division of Raybestos-Manhattan, Inc. 56-page catalog describing belting, hose, fittings, packing, friction material, etc.

V19. Rubber Goods—New York Belting & Packing Co. Mechanical Rubber Goods Catalog on hose, belting, packing.

Lubrication

V20. Lubrication—Alemite Corp. 25-page catalog on lubrication equipment.

V21 and 22. Lubrication—S. F. Bowser & Co., Inc. 11-page "Pulp and Paper Mill Lubrication," and 48-page "Lubrication of Steel Mill Machinery.'"

V23. Lubrication—Ideal Lubricator Co. 30-page booklet describing system for lubricating bearing surfaces.

V24, 25, 26, 27, 28. Lubrication—Standard Oil Co. (Indiana), Series of engineering monographs on industrial lubrication, including "The Lubrication Engineer Has Value to You, "The Lubrication of Diesel Air Compressors," "Diesel Engine Bearing Lubrication," "The Lubrication of Meters in Jordan," "The Lubrication of Mine Locomotives." Competent engineering data.

V29. Oil Test—C. J. Tagliabue Mfg. Co. Bulletin No. 1098 describes 4-compartment "cold test" apparatus for A.S.T.M. cloud-pour test of lubricating oils.

V30. Turbine Oil Purification—S. F. Bowser & Co., Inc. 16-page, Book F on systems for maintaining turbine oil.

General

V31. Aftercoolers—Ingersoll-Rand Co. 12-page catalog, "Aftercoolers for Air or Gas."

V32. Air Nozzles—Lunkenheimer Co. Booklet No. F-533A on bronze air nozzles with renewable, non-metallic disks for blowing dust, dirt, sand, liquid deposits, etc.

V33. Boulder Dam—Ingersoll-Rand Co. 48-page "The Story of Boulder Dam."

V34. Blast Gates—W. S. Rockwell Co. Catalog No. 353, "Kwikleen" blast gates.

V35. Brewery Equipment — Worthington Pump & Machinery Corp. 12-page bulletin WP-1069, "Worthington Equipment for Breweries."

V36. Carbide Residue—Linde Air Products Co. 20-page booklet explains how residue acetylene generators may be used.

V37. Diesel School—U. S. Diesel Engineering School. 27-page catalog gives personnel, description of "Courses and Other General Information."

V38. Forged Flanges—Kropp Forge Co. 4-page folder on forged boiler flanges.

V39. Holyoke—Holyoke Water Power Co. 12-page folder, city and industrial facilities.

V40. Maintenance—Stonhard Co. 24-page guide for keeping floors, roofs, walls and foundations in repair.

V41. Research Institution—Battelle Memorial Institute. Booklet describes Institute's facilities for research.

V42. Respirators—Pulmosan Safety Equipment Corp. 3 folders describing respirators for hazardous locations.

V43. Safety Signal—Martindale Electric Co. Bulletin No. 322 describes safety signals, automatic, men working signs, etc.

V44. Screws, Bolts, Nuts—Pheoll Mfg. Co. 1936 catalog, 104 pages, on screws, bolts and nuts.

V45. Separators—Westfalia Separator Co. Series of five catalogs covering separators.

V46. Soot Blowers—Diamond Power Specialty Corp. 8-page reprint of steam plant tables in June, 1934, Power.

V47. Specialties—Hills-McCanna Co. Catalog on products, including alloys, lubricators, valves, thermometer wells, pyrometer protection tubes, and grease pumps.

V48. Steam-Jet Ejectors—Elliott Co. Bulletin describing range of ejectors.

V49. Steel-Mill Plants—General Electric Co. Bulletin GEA-2125, "Super-imposed Steam Turbine-generator Plants for the Steel Mill," by A. G. Darling, reprinted from "Iron and Steel Engineer."

V50. Stop Nut—Elastic Stop Nut Corp. 16-page Catalog No. A-43 contains applications for elastic stop nuts.

V51. Strainer—Edward Valve & Mfg. Co. Catalog No. 11-G4 on forged steel strainers for high- and low-temperatures and pressures.

V52. Testing Screens—Hendrick Mfg. Co. Folder describes line of testing screens.

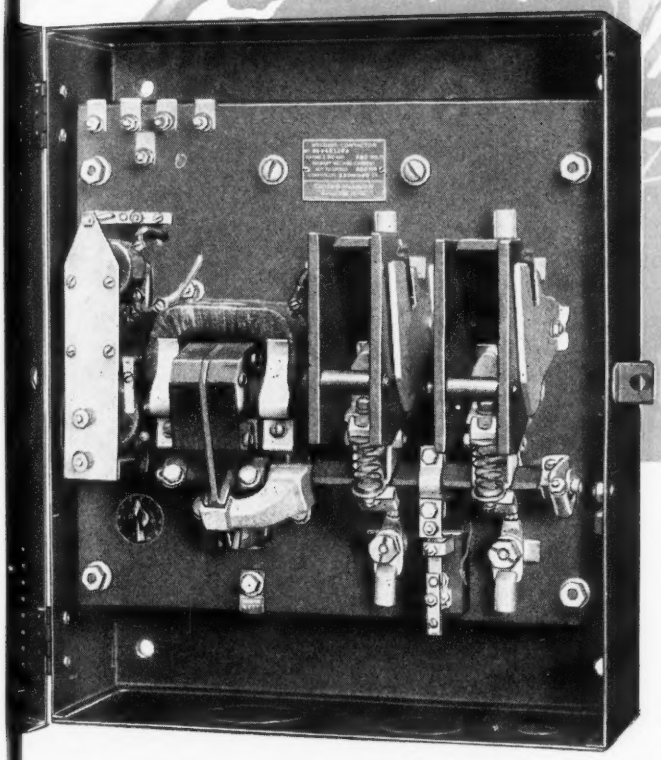
V53. Vibrating Screen—Robins Conveying Belt Co. 4-page Vibrex Screen Bulletin No. 93.

V54. Washers and Stampings — Wrought Washer Mfg. Co. Handbook, "Special Washers and Stampings."

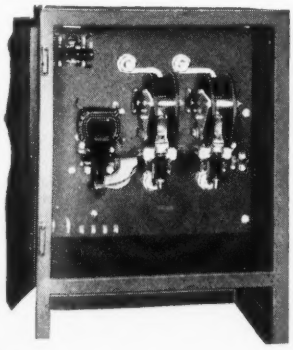
V55. Water Analysis—W. H. & L. D. Betz. 18-page booklet, "Interpretation of Water Analysis."

V56. Water Systems — Roots-Connerville Blower Corp. 2-page Bulletin 260-B-13 on water systems for wells and cisterns.

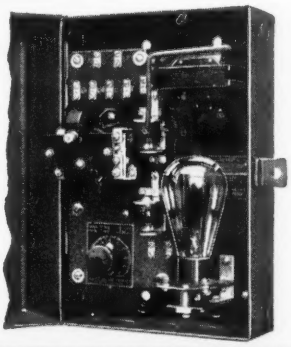
NEWS! PRODUCTION WELDING GOES *AUTOMATIC*



C-H "Hot Shot" Welding Control complete with Inductive Timer and "Split-Second" Contactor in one case. Timing, once set by the convenient dial, produces an endless succession of perfect welds. C-H "Hot Shot" Welding Control is unaffected by vibration, absolutely dependable and accurate under all operating conditions. Its operating range is from 1/20th to 3/5ths second, accurate to 1/120th to 1/240th second.



No small part of the dependability of C-H Welding Control installations is due to the unusual characteristics of the C-H "Split-Second" Welding Contactor. The 900 Ampere Double Pole Type in floor style enclosing case is illustrated at left.



The C-H "Split-Second" Tube Timer (shown at right) has a range up to 2 seconds and, by special construction, can be built to provide an interval of several times this duration.

Amazing New Speed, New Economies, New Accuracy Brought by C-H "Hot Shot" Welding Control

Resistance welding, spot, projection, butt or flash, has now become a dependable high speed production operation. With C-H "Hot Shot" Control all guesswork is eliminated. The flow of current is accurately timed to 1/120th part of a second . . . to produce a continuous run of *perfect* welds . . . at amazing speed . . . at marked savings.

Utilizing the famous Cutler-Hammer system of *inductive* timing so well known in C-H steel mill Motor Control, this "Hot Shot" Welding Timer is free from troublesome mechanical timing means or fragile elements. Its ruggedness, its unfailing dependability, its unchanging accuracy have been proven in hundreds of installations. Write or wire for detailed information. CUTLER-HAMMER, Inc., *Pioneer Manufacturers of Electric Control Apparatus*, 1358 St. Paul Avenue, Milwaukee, Wis.

CUTLER-HAMMER *Welding* CONTROL

MAKES WELDING A DEPENDABLE C-H HIGH SPEED PRODUCTION OPERATION

LUCKY NUMBAH . . .

"Geee-n-tulmen, the lucky numbah winning the turkey for this spin of the wheel is . . . ." Remember the old turkey raffles that every corner saloon put on on the night before Thanksgiving, Christmas and New Year's? When I was a young fellow, one of my friends was called "Lucky" just because he always won turkeys enough for the rest of us. He told me the answer not so long ago. When he went to a raffle, he didn't buy a paddle for the first couple of spins. He stood back instead, and watched to see where the wheel was out of balance (in the old days they almost always were), then bought paddles for the numbers that came up oftenest.

We called him "Lucky," but he was just using his head. Common sense and experience help a lot, even in betting on horse races.

The same thing shows up in what some people call "snap guesses." Most of the time, if a fellow has a good record for his snap guesses, they're not guesses at all. He has just stored a bunch of facts and principles away in the back of his bean for just such an emergency. When an engineer faced with a steam-line failure brings out a dramatic way to avoid it, or when he rigs up a special hoisting rig, he's not guessing; he's adding together the results of dozens of experiences with similar troubles over a long period of time and getting an answer.

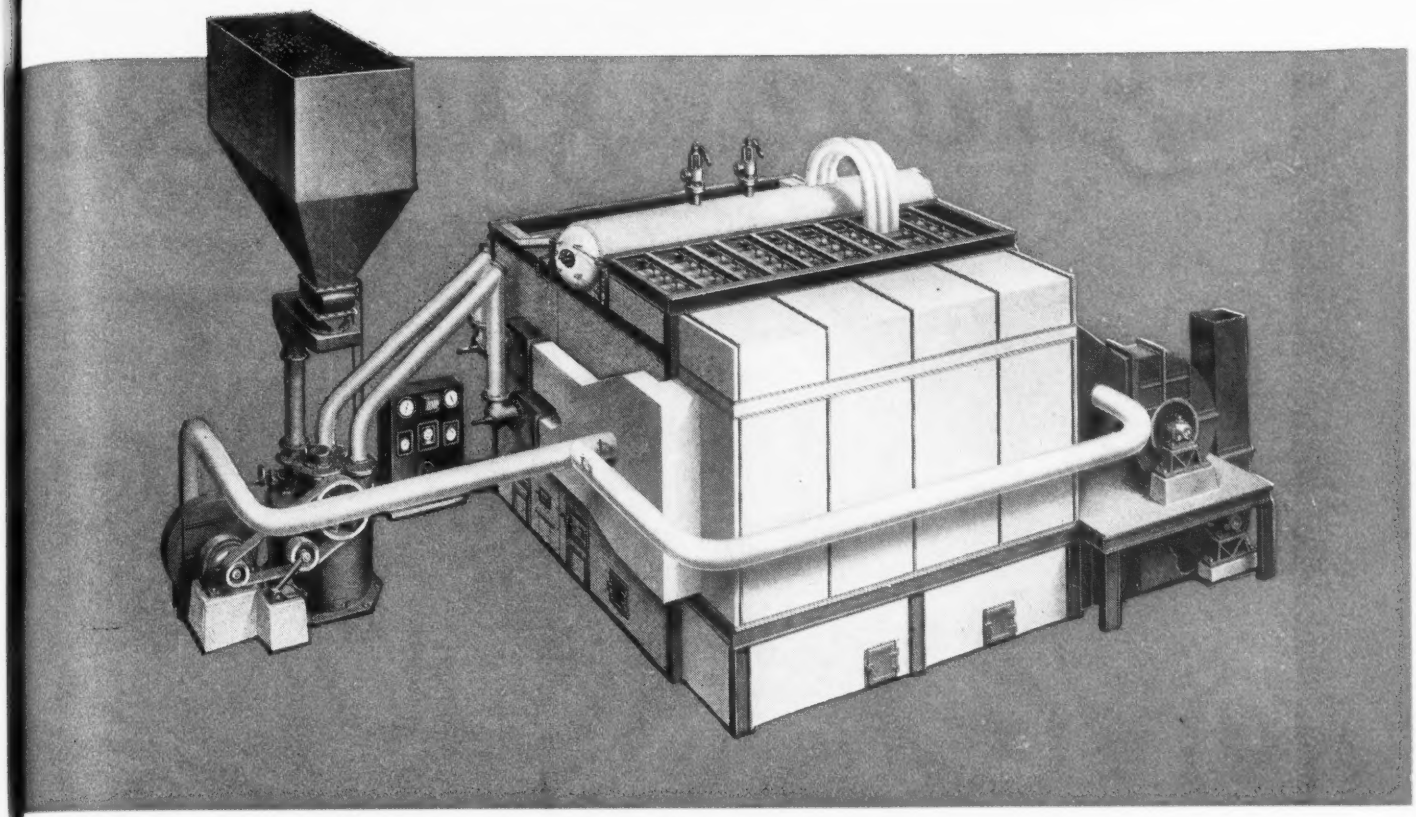
Men like that are best to work with or for. An industrial mogul once said that the reason he was successful was that he always "associated himself with lucky men." Their luck wasn't luck at all; it was common sense, judgment, and experience all rolled together to get a new kind of smoke. You can bet on a man like that—his record of successes may look like luck to some people but it looks like plain horse sense to me.

Of course, experience isn't always the best teacher. I know men I wouldn't hire on a bet. They always "just happen" to be there when something goes wrong, "just happen" to have worked with outfits that went on the rocks. Experience rolls off of them like water off a duck's back. They get as far with a lifetime of experience as a squirrel does in a cage—when they get through, all they've had is exercise.

The other kind of man remembers and learns. He doesn't wait until the horse is stolen before he locks the barn, nor let his leaky roof go until a rainstorm keeps him inside and keeps him from fixing it. He gets ready beforehand. Then, when trouble comes, he isn't the unlucky guy who is forever getting floored by it. He figures on a certain amount of trouble and gets ready for it beforehand; he's got a first-aid kit for almost anything that may come up. His scrap pile is outside the plant, not inside; and he hasn't any room for "unlucky" ideas or men.

George Edwards

GEORGE EDWARDS
Engineer



profitable modernization

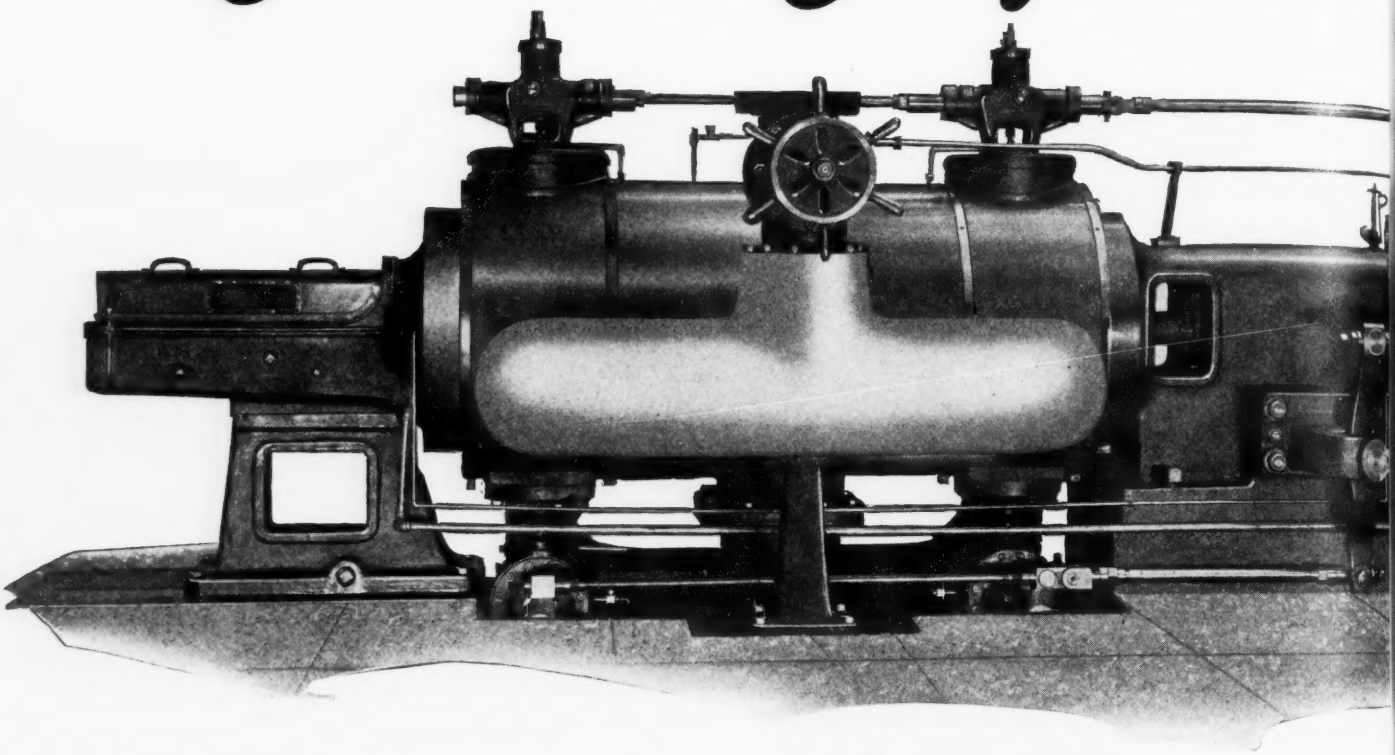
The Integral-Furnace Boiler is an example of an efficient, complete and fully-coordinated unit, including these designs and constructions to meet modern requirements. It contains such advanced features as: cross-flow of gases for maximum heat transfer, a water-cooled furnace, and multi-fuel burners that permit the use of pulverized coal, oil or gas, fired singly or in any combination.

Those interested in reducing the cost of power or process steam should investigate this modern unit . . . one that is particularly suitable for both small and large power plants where continuity of service and high overall economy are required, and one that has effected phenomenal savings.

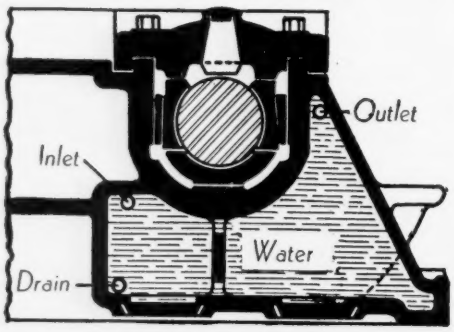
The Babcock & Wilcox Company . . . 85 Liberty Street . . . New York.

BABCOCK & WILCOX

Elliott Engines



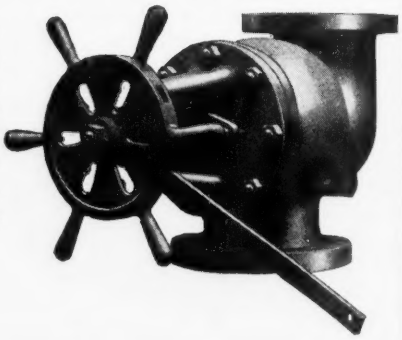
Water-cooled main bearings.



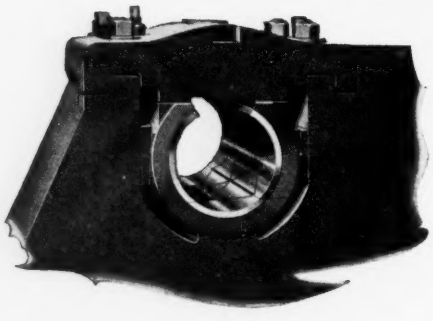
Elliott engines are the first to be built with water-cooled main bearings as standard equipment. Additional use is made of this feature by also cooling the circulating oil. Operating engineers appreciate this extra provision for dependable operation.

A new type throttle wheel,

with pilot handles, also sockets and lever, to give greater power for opening or closing. Eliminates wrench or bar.



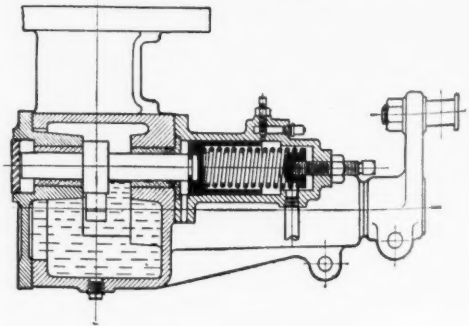
Three-part main bearing.



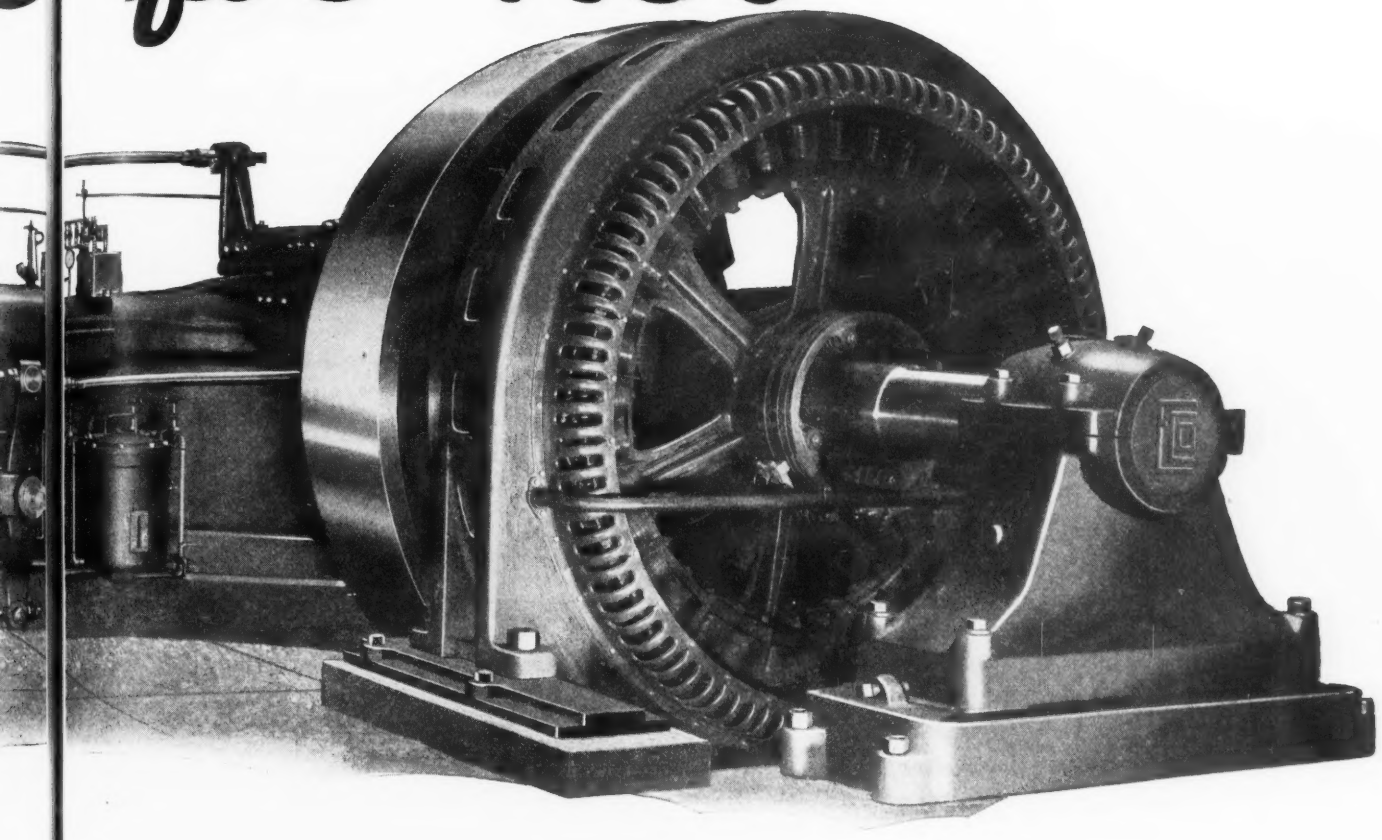
Quarterbox construction. Reinforced babbitt. Fully adjustable without the use of shims. Ample grooves carry a flood of oil, but the bearing is sealed against leakage into the wheel and generator.

Automatic exhaust change-over device

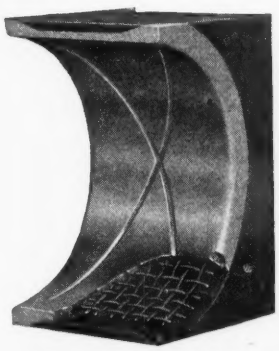
provides for both condensing and non-condensing operation where required.



for 1936



Reinforced babbitt



recently introduced by Elliott, has greatly improved crank pin and main bearing shells, eliminating loosening and cracking of babbitt. Reinforcing babbitt is just as effective as reinforcing concrete.

The perfection of any machine is a slow development involving the life work of many men. The steam engine, from James Watt to this day, is going through this evolution.

In Elliott Engines for 1936, we believe that the steam engine makes its closest approach to perfection. It is the best steam engine we have ever built in our 46 years of engine-building experience. The few details shown here are merely representative of many refinements and improvements throughout the 1936 Elliott Engine.

Elliott engineers will be glad to give you the whole story of these engines, and to advise with you as to the best type of engine — single-valve or four-valve counterflow; poppet-valve or Corliss-valve unaflow — for your particular plant and individual conditions. For immediate information, write us for Bulletin B-3.

ELLIOTT COMPANY

PITTSBURGH, PA.

Steam Engine Department, RIDGWAY, PA.

District Offices in Principal Cities

The

1935 ROLL CALL

of those industrial manufacturers* who use

American *Hammered* Piston Rings

as standard equipment

★ *Exclusive of the Automotive Industry*

A product — as well as a person — may be judged "by the company it keeps"—and American Hammered is well content that the judgment of industrial America should be predicated upon this roll call of the country's major equipment manufacturers. The list on the following page—virtually a blue book of American industrial leaders — includes only those who used our products in 1935. Many of them have used American Hammered Piston Rings exclusively for many years.

The engineering and product design staffs of these great manufacturers of industrial equipment have subjected American Hammered Piston Rings to rigorous tests. They know—as no one else could know—the exact requirements of their own equipment. They've found that American Hammered Piston Rings *best meet those requirements.*

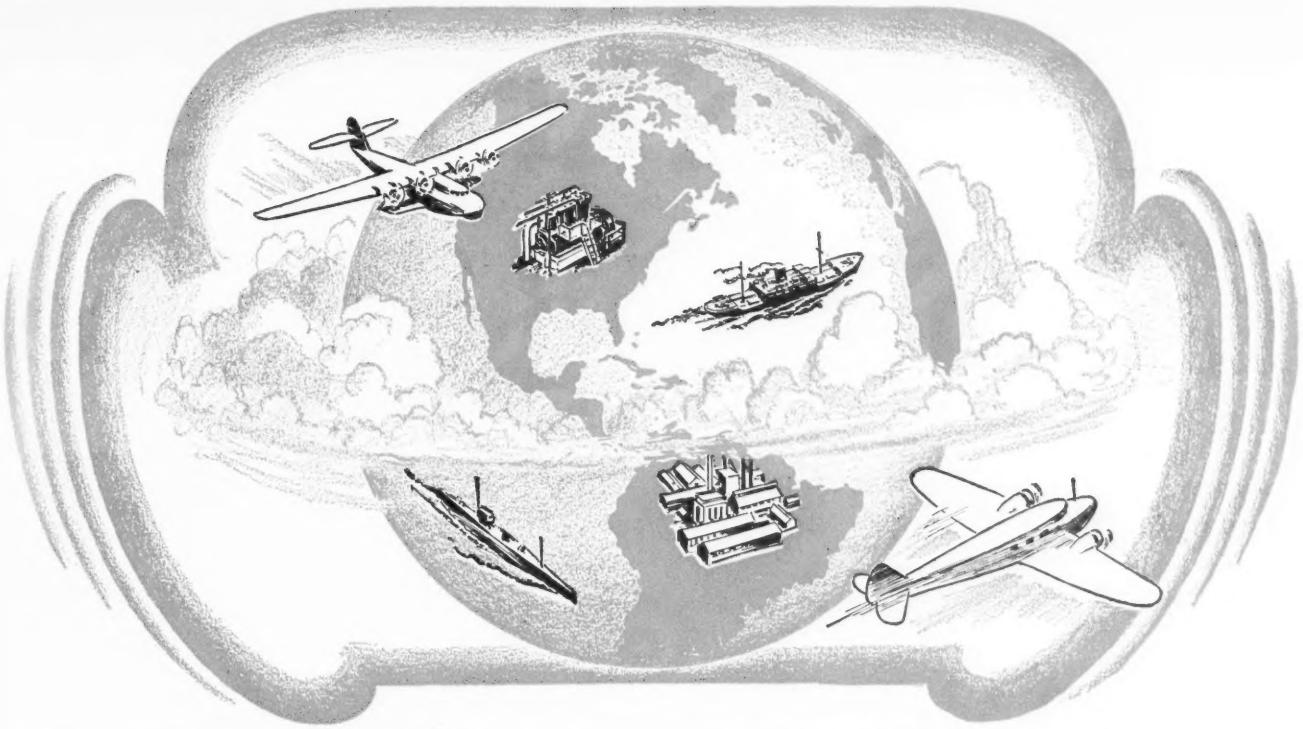
American Hammered Engineering Service is available to users of equipment produced by these great companies

Those who specify American Hammered Piston Rings as standard equipment have provided the users of their products with what they believe — and we believe — to be the rings that serve best and save most. In their own best interests users of these products should themselves specify "American Hammered" when piston ring replacements are needed.

In specifying American Hammered Piston Rings as standard equipment, these manufacturers have done the users of their products another good turn. For their selection of American Hammered Piston Rings also makes available at any time to all users of their products the services of the American Hammered field and headquarters staff of piston ring engineers. Don't hesitate to call on us when you have a piston ring problem of any kind.

AMERICAN HAMMERED PISTON RING COMPANY
Division of The Bartlett Hayward Company
"Serving Industry as Founders and Engineers since 1832"
BALTIMORE, MARYLAND

American Hammered

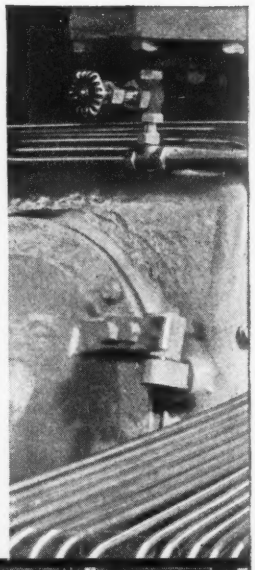


AJAX IRON WORKS — *Steam Engines*
AMERICAN CHAIN COMPANY — *Air Compressors*
AMERICAN ENGINEERING COMPANY — *Air Compressors*
ATLAS IMPERIAL DIESEL ENGINE CO. — *Diesel Engines*
BALDWIN SOUTHWARK CORPORATION — *Diesel Engines, Compressors, Refrigerating Machinery, Hydraulics*
BETHLEHEM STEEL COMPANY — *Gas Engines*
BOVAIRD & SEYFANG MFG. COMPANY — *Gas Engines*
BRUCE MacBETH ENGINE COMPANY — *Gas Engines, Diesel Engines*
BRUNNER MANUFACTURING COMPANY — *Air Compressors, Refrigerating Machinery*
CARRIER ENGINEERING COMPANY — *Refrigerating Machinery*
CATERPILLAR TRACTOR COMPANY — *Diesel Engines*
CHICAGO PNEUMATIC TOOL COMPANY — *Diesel Engines, Compressors*
CLARK BROTHERS COMPANY — *Gas Engines, Diesel Engines, Compressors*
CONTINENTAL AIRCRAFT COMPANY — *Aircraft Engines*
COOPER-BESSEMER CORPORATION — *Diesel Engines, Gas Engines, Compressors*
CRANE COMPANY — *Valves*
CURTIS MANUFACTURING COMPANY — *Air Compressors*
M. T. DAVIDSON COMPANY — *Pumps*
DOMESTIC ENGINE & PUMP COMPANY — *Steam Engines, Pumps*
ELECTRIC BOAT COMPANY — *Diesel Engines*
FAIRBANKS, MORSE & COMPANY — *Submarine Diesel Engines*
FOSTER PUMP WORKS — *Pumps*
FOSTER ENGINEERING CO. — *Valves*
FRANKLIN VALVELESS ENGINE CO. — *Gas Engines, Diesel Engines*
FRICK COMPANY — *Refrigerating Machinery*
GARDNER DENVER COMPANY — *Air Compressors*
GENERAL ELECTRIC COMPANY — *Air Compressors*
HALLETT MANUFACTURING COMPANY — *Compressors*
HEISLER LOCOMOTIVE WORKS — *Steam Locomotives*
HITCHCOCK GAS ENGINE COMPANY — *Gas Engines*
HOOVEN OWENS RENTSCHLER CO. — *Diesel Engines*
HYDRAULIC PRESS MFG. COMPANY — *Hydraulic Presses*
INDUSTRIAL BROWNHOIST CORP. — *Hoists*
INGERSOLL-RAND COMPANY — *Diesel Engines, Air Compressors, Pumps*
KELVINATOR CORPORATION — *Refrigerating Machinery*
KINNER AIRPLANE & MOTOR COMPANY — *Aircraft Engines*
KOHLER COMPANY — *Farm Lighting Machinery*
LATHROP ENGINE COMPANY — *Gasoline Engines*
LESLIE COMPANY — *Valves*
LIDGERWOOD MFG. COMPANY — *Hoists*
McINTOSH & SEYMOUR CORPORATION — *Diesel Engines*
MARION STEAM SHOVEL COMPANY — *Excavators*
MAYTAG COMPANY — *Gasoline Motors*
MESTA MACHINE CO. — *Special Machinery*
MIEHLE PTG. PRESS & MFG. COMPANY — *Printing Presses*
NATIONAL-SUPERIOR COMPANY — *Steam Engines*
NORWALK COMPANY — *Air Compressors*
PENNA. PUMP & COMPRESSOR CO. — *Air Compressors*
PRATT & WHITNEY AIRCRAFT — *Aircraft Engines*
RATHBUN JONES ENGINEERING CO. — *Diesel Engines*
JOSEPH REID GAS ENGINE COMPANY — *Gas Engines, Diesel Engines*
ROBINS CONVEYING BELT COMPANY — *Conveyors*
SCHUTTE & KOERTING COMPANY — *Valves*
SEAGRAVE CORPORATION — *Gasoline Engines*
SHAFER BEARING CORPORATION — *Bearing Seals*
S. MORGAN SMITH COMPANY — *Hydraulic Machinery*
STANDARD MOTOR CONSTRUCTION CO. — *Diesel Engines*
STANDARD STOKER COMPANY — *Stokers*
STERLING ENGINE COMPANY — *Diesel & Gasoline Engines*
STRUTHER WELLS-TITUSVILLE CORP. — *Gas Engines*
SUN SHIPBUILDING & DRY DOCK CO. — *Diesel Engines*
TABOR MANUFACTURING COMPANY — *Molding Machines*
TROY ENGINE & MACHINE COMPANY — *Steam Engines*
UNION SWITCH & SIGNAL COMPANY — *Automatic Train Control*
UNITED ENGINEERING & FOUNDRY CO. — *Hydraulic and Special Machinery*
UNIVERSAL COOLER CORPORATION — *Refrigerating Machinery*
VENN-SEVERIN MACHINE COMPANY — *Diesel Engines*
WESTINGHOUSE ELECTRIC & MFG. CO. — *Diesel Engines, Compressors*
WILSON-SNYDER MANUFACTURING CO. — *Steam Engines, Pumps*
WOLVERINE MOTOR WORKS — *Diesel Engines*
WORTHINGTON PUMP & MACH. CORP. — *Diesel Engines, Steam Engines, Pumps, Compressors*
WRIGHT AERONAUTICAL CORP. — *Aircraft Engines*
YORK ICE MACHINERY CORPORATION — *Refrigerating Machinery*

PISTON RINGS

. . . "Products "Engineering Service

—reports McMinnville, one of the largest Diesel plants in the Northwest

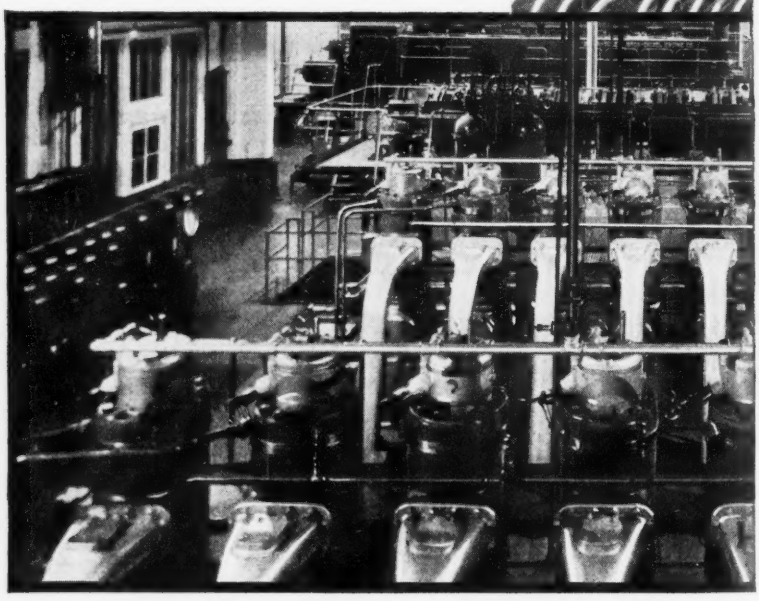


Lubrication has two objectives—reduce operating costs—insure more continuous operation. In the 1500 h.p. Busch-Sulzer Diesels of the municipal lighting plant at McMinnville, Oregon, Texaco Ursa Oil has done both.

From the original charge, Texaco Ursa has been in the system for more than four years of continuous service. Tests have shown that the oil is in fine condition. The engines are operating perfectly. Maintenance and operating expenses have been remarkably low and power costs have been reduced 25%.

This is but one example. Texaco Ursa Oil in hundreds of other plants of all types, is showing equally valuable results. When the Texaco representative calls ask him about some of these results and see what Texaco will do for you.

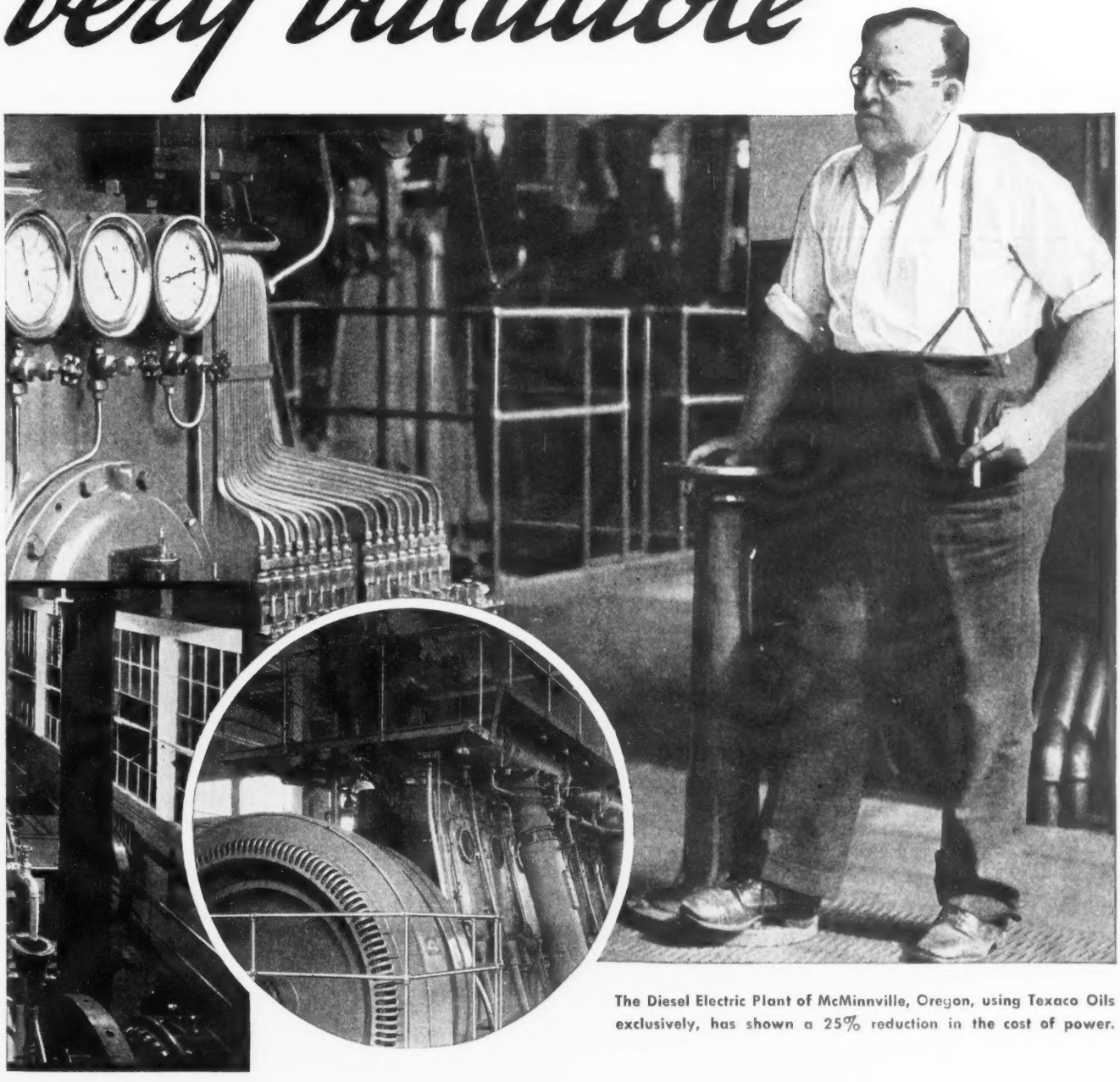
THE TEXAS COMPANY
135 East 42nd Street • New York City
Nation-wide distribution facilities assure prompt delivery



TEXACO TEXACO **T** REG. U. S. PAT. OFF. *tested*

REFINERY TESTED FOR UNIFORMITY . .

very satisfactory"
very valuable"



The Diesel Electric Plant of McMinnville, Oregon, using Texaco Oils exclusively, has shown a 25% reduction in the cost of power.

LUBRICANTS

• • SERVICE TESTED FOR ECONOMY

MECHANICAL CONTROL . . . METERING

In the boiler room mechanical control is the DOER . . instruments the WITNESS

A complete boiler control installation includes mechanical control equipment and instruments. It is the sole function af the mechanical control equipment to operate the boilers efficiently. It is the responsibility of the instruments to accurately check the result. Obviously if the instruments are to present a true picture of operating conditions they must function independently of the control equipment.

To meet these basic requirements, the Republic Flow Meters Co. now offers, for the first time, a complete service in the field of measurement and control.

Write for Data Book No. S-11 on Smoot Regulators and Data Book No. S-20 on Mechanical Combustion Control.

IS ONE THING . . .

IS ANOTHER

SMOOT CONTROLS: A full line of control equipment for the mechanical control of steam pressure, combustion, furnace pressure, excess pressure, load distribution, etc. Can be furnished for all sizes and types of boilers and fuel firing equipment.

REPUBLIC INSTRUMENTS: A complete line of power plant instruments including Flow Meters, CO-2 Meters, Draft Instruments, Thermometers, Level Gauges, etc. Master panels are designed and built to meet special requirements and may include any combination of instuments desired.

Our engineering department will be glad to cooperate with you in the solution of any metering or control problem whether it envolves one instrument or a complete system. This service is made available through a nation-wide organization of sales and service engineers.

REPUBLIC INSTRUMENTS SMOOT CONTROL

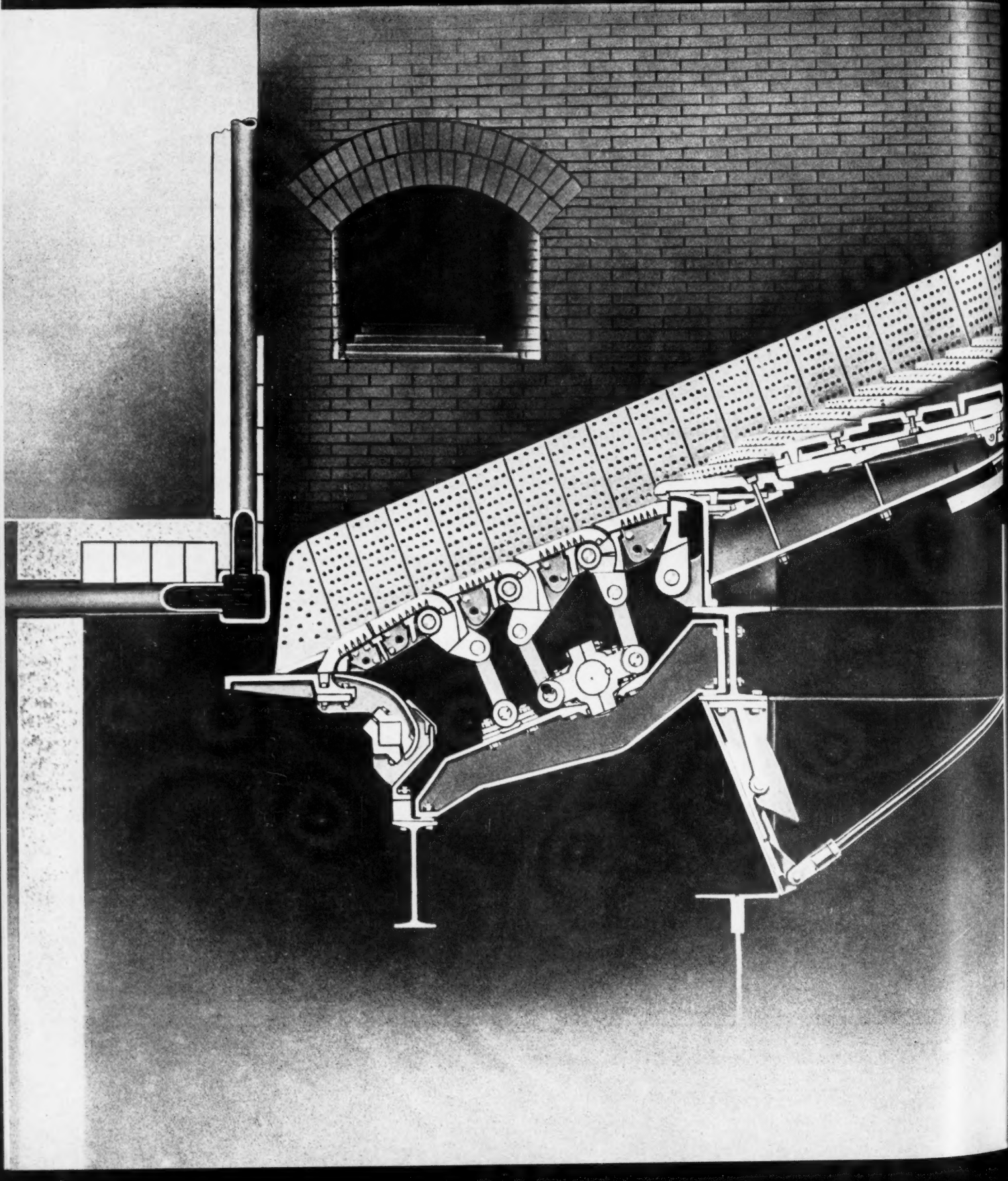
REPUBLIC FLOW METERS CO.

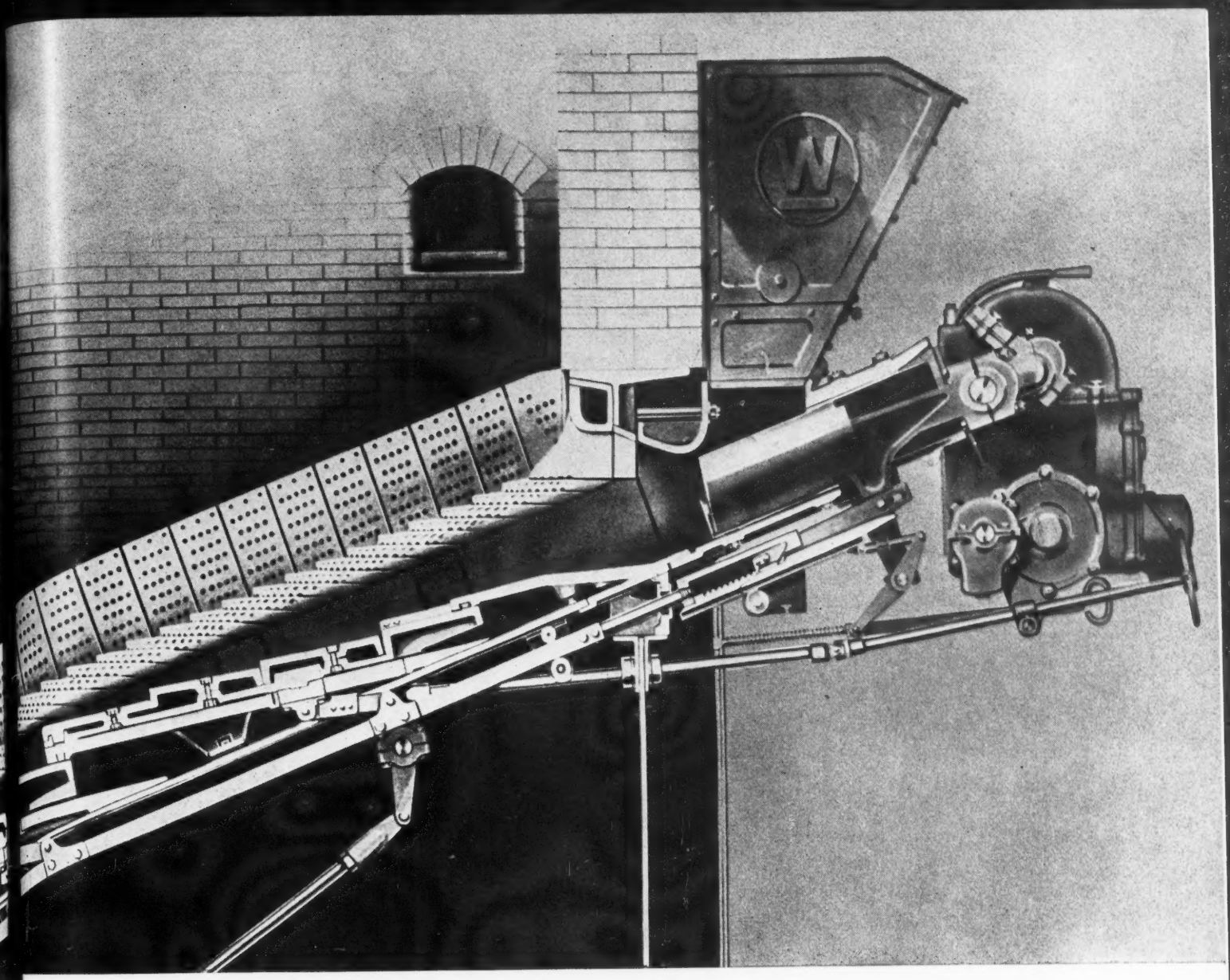
2222 DIVERSEY PARKWAY, CHICAGO, ILLINOIS

BRANCH OFFICES IN ALL PRINCIPAL CITIES

We Will Gladly Mail These Data Books Upon Request Without Obligation.

WESTINGHOUSE CONTINUOUS-ASH-DISCHARGE LINK-GRATE STOKER





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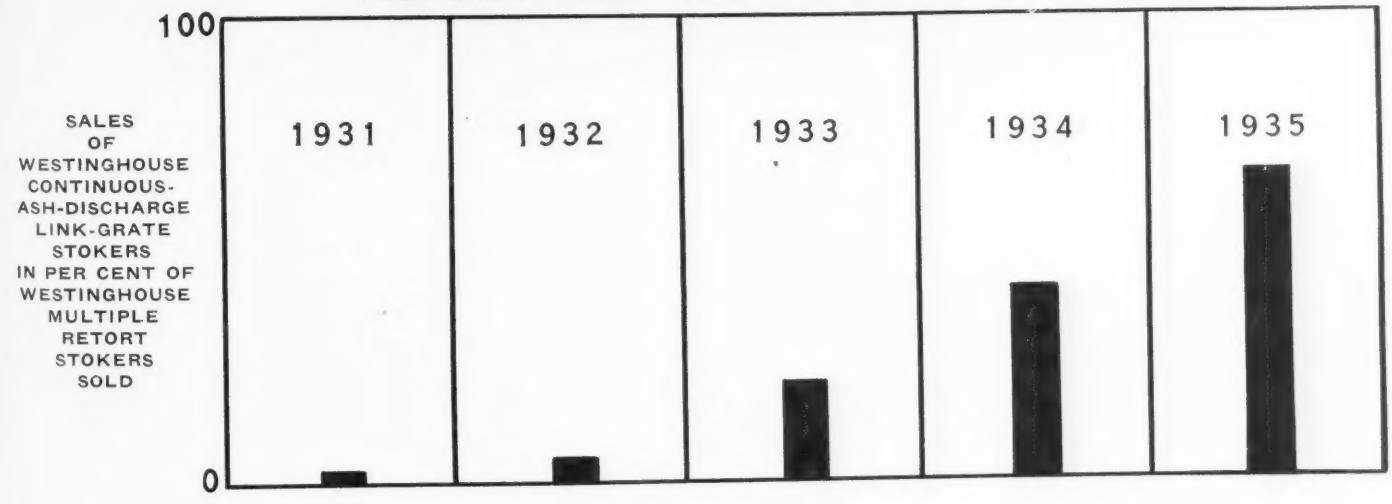


Westinghouse *Stokers*

Let *POWER*

TAYLOR RECORDING THERMOMETER—In appearance, design and construction the highest type of modern recorder available today. Three types—Mercury-, Gas-, and Vapor-Actuated. Mercury type uses Taylor Accuratus Tubing designed to compensate for temperature changes through which tubing passes and to assure correct bulb temperature readings. Dust-proof and moisture-proof cases for face- or flush-mounting. Many styles of standard bulb assemblies are available to accommodate all types of apparatus.

Study its Accurate Record as written by the pens of Taylor Recording Thermometers and Pressure Gauges

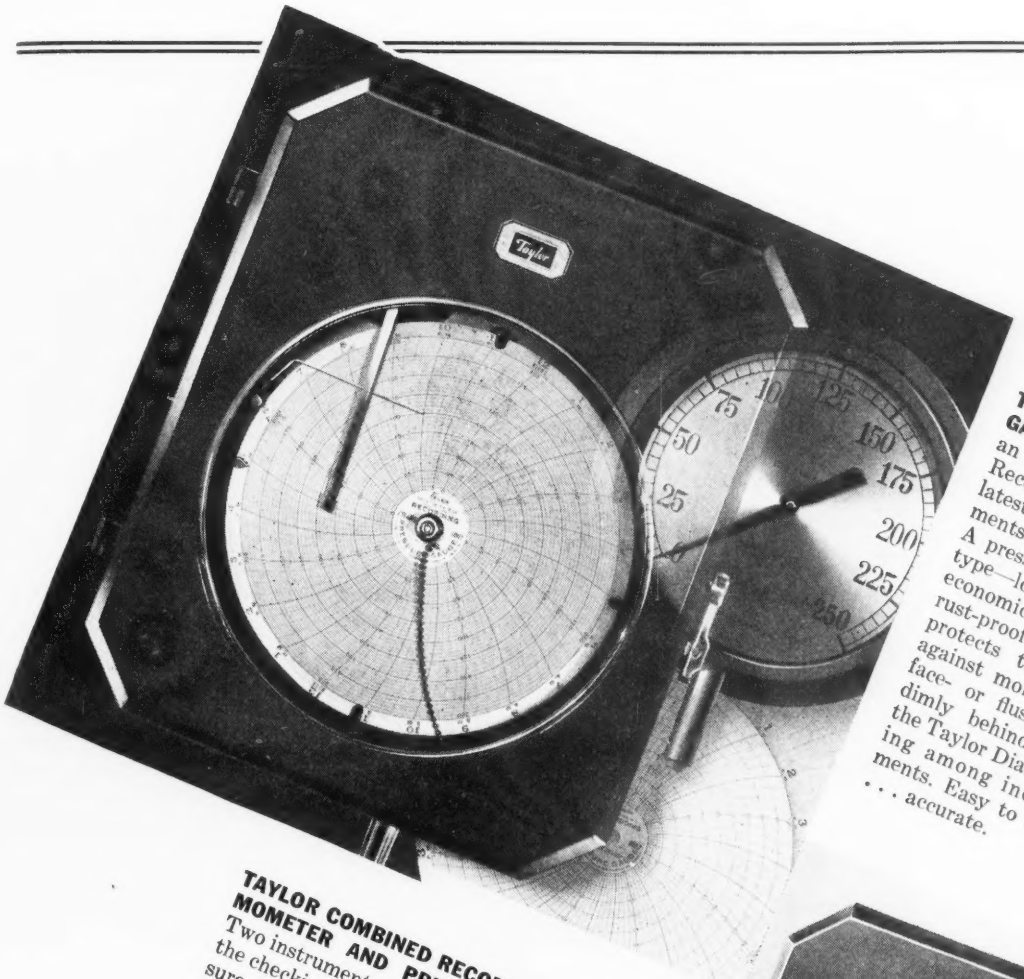
WHO ever thought of power writing its life history? But it does—in terms of temperature and pressure, with the pens of recording thermometers and gauges. The chart chapters are vital records for every power plant. But they must be accurate records—reliable records—the truth and nothing but the truth.

Through the medium of Taylor Recording Thermometers and Pressure Gauges, power plants get precise and accurate records today. These instruments are designed from beginning to end to meet the most exacting requirements in connection with the production of power. They are built to be accurate—and to give exceptionally long and economical service. Their charts are printed on specially developed paper to eliminate reaction to atmospheric changes and to provide the ideal writing surface.

Shown above are three types of modern Taylor Recorders designed for power plant use. A Taylor Recording Thermometer, a Recording Pressure Gauge, and a combined Recording Thermometer and Pressure Gauge, a necessity for superheated steam lines. For more complete information regarding these instruments, write for Catalog 68J on Temperature Recorders and Catalog 68JF on Pressure Recorders. For more direct data on these and any other Taylor Instrument for Power Plants, ask a Taylor Representative to cover the ground with you.

For Catalogs or a Taylor Representative, address Taylor Instrument Companies, Rochester, N. Y., or Toronto, Canada. Manufacturers in Great Britain—Short & Mason, Ltd., London, England.

write its Autobiography



TAYLOR RECORDING PRESSURE GAUGES—As fine and accurate an instrument as its brother Recorder of temperature. With latest refinements and improvements in design and construction A pressure gauge of the highest type—long lasting, efficient and economical in operation. In a rust-proof die-cast case which protects the inner mechanism against moisture and dust. For face- or flush-mounting. Shown dimly behind the Recorder is the Taylor Dial Gauge, outstanding among indicating instruments. Easy to read . . . durable . . . accurate.

TAYLOR COMBINED RECORDING THERMOMETER AND PRESSURE GAUGE—Two instruments in one. So as to simplify the checking of the temperature and pressure of superheated steam. There is also a three-pen instrument to show two pressures and one temperature, or two temperatures and one pressure. This instrument contains all the many features and improvements to be found in all Taylor Recorders to assure complete accuracy, economy and long life in service.

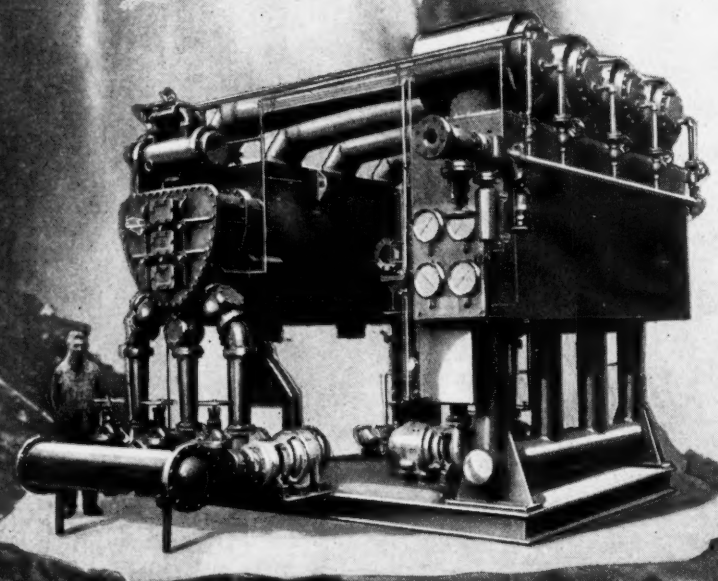
Taylor

Indicating Recording • Controlling

TEMPERATURE, PRESSURE AND FLOW INSTRUMENTS

WATER-VAPOR REFRIGERATION

A simple, economical method of cooling water for industrial uses and air conditioning



Usually, natural supplies of cold water for refrigeration are physically or economically impossible, thus making it necessary to cool circulated water.

In I-R Water-Vapor Refrigerating Units, cooling is accomplished by direct evaporation (under vacuum) of some of the water itself. No chemicals are used. The system is safe and economical.

Two types of units—Steam-Jet (illustrated) and Centrifugal—permit the selection of the most economical equipment to meet widely varying conditions of steam or electric power, cooling water supply and refrigerating requirements.

Let us tell you about the overload capacity, the sustained efficiency and other advantages of I-R Water-Vapor Refrigerating Units serving manufacturing processes and air-conditioning units throughout the country.

Ingersoll-Rand

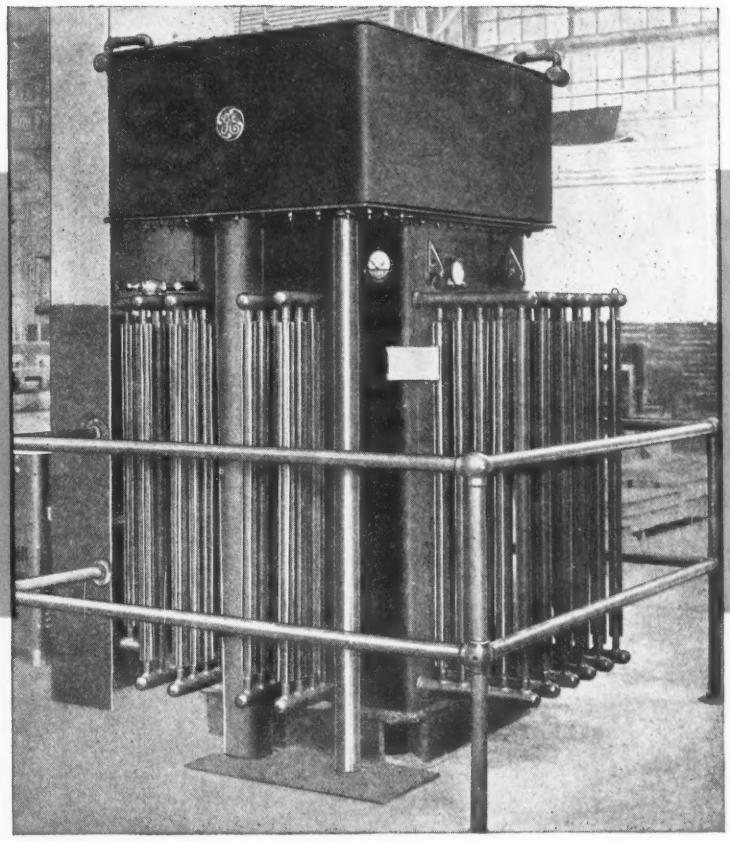
DWAY, NEW YORK CITY

Principal Cities the World Over

YOU WILL PROFIT BY USING G-E PYRANOL TRANSFORMERS

FOR SUCH APPLICATIONS AS

- Indoor installations in apartment, office, hospital, hotel, school, and theater buildings
- Industrial plants
- Sidewalk and street vaults
- Mines, tunnels, and subways
- Railway cars, locomotives, docks, and ships



Pyranol power transformer, 900 kva, 2300 to 230 volts, 60 cycles. Supplying power to electric annealing furnaces. A saving of 23 per cent in total installed cost was made by the use of a Pyranol transformer

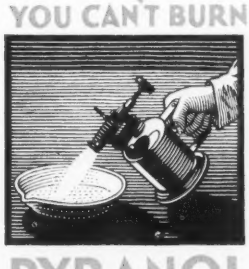
IT is possible to meet the safety requirements of the National Electrical Code for indoor installations more economically with G-E Pyranol transformers than with oil-filled units, because with Pyranol transformers many restrictions are eliminated.

All Ratings Available

G-E Pyranol transformers are available in all kva and voltage ratings. They are designed and built especially for use with Pyranol, the noninflammable and nonexplosive cooling and insulating liquid.

Service Records Prove Dependability

The remarkable service record of more than 250 Pyranol transformers, many of which have been in operation for more than three years, has proved their dependability, and verified the conservative nature of the claims made for them.

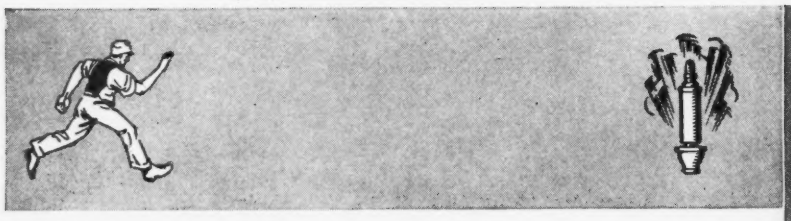


For further information, ask the G-E office nearest you for a copy of Bulletin GEA-2048, or write to General Electric Co., Schenectady, New York.

PYRANOL— The Most Important Transformer Development Since Silicon Steel

300-27

GENERAL ELECTRIC



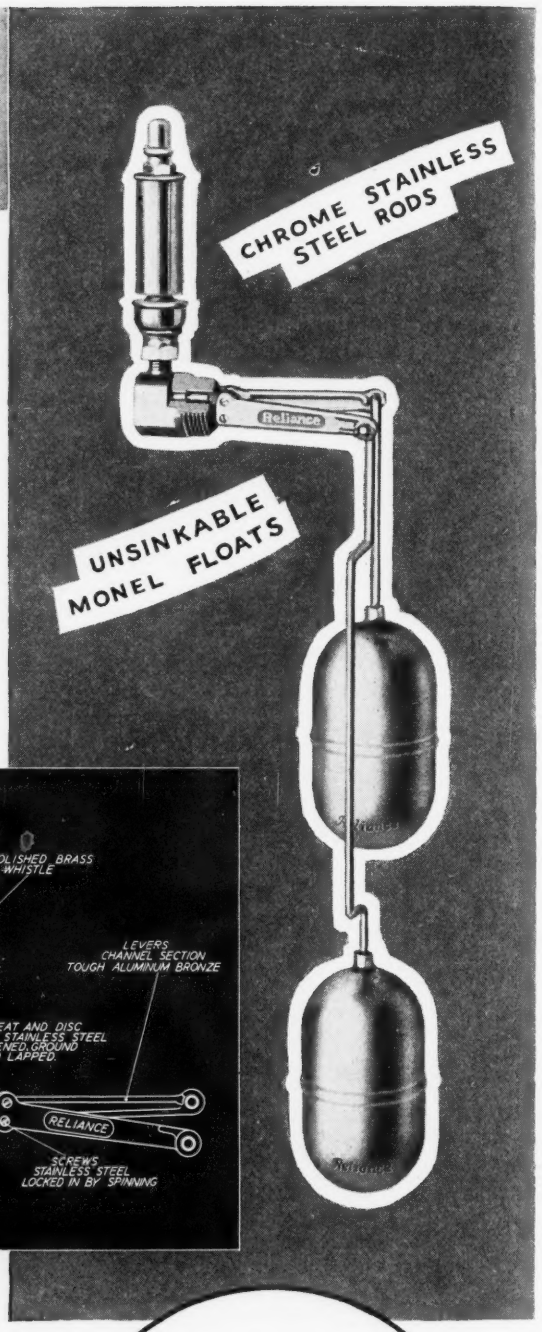
THAT WHISTLE *Always* BLOWS

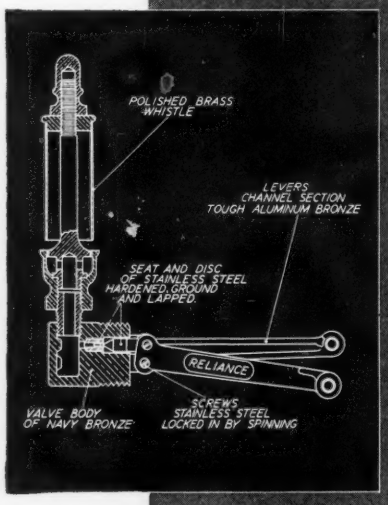
IF YOU don't have absolute certainty that a safety device is always going to work, it simply isn't a safety device.

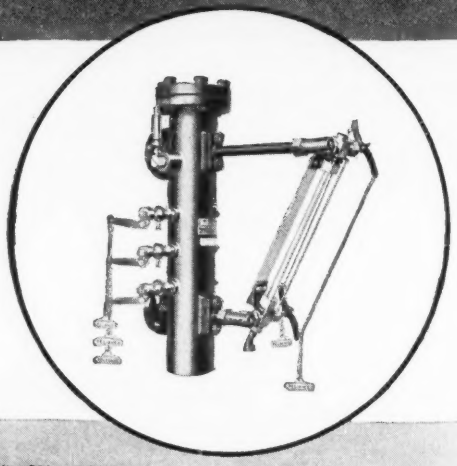
Reliance boiler alarms qualify. They work every time. Low water, high water —the whistle blows, the electric signal is given.

Instantly! No puttering sluggishly around, no delay to overcome inertia. Alert, almost alive, the Reliance responds immediately on less than a quarter inch variation in water level.

Free working mechanism does it, activated by highly buoyant monel floats, guaranteed unsinkable in service.




POLISHED BRASS WHISTLE
LEVERS CHANNEL SECTION TOUGH ALUMINUM BRONZE
SEAT AND DISC OF STAINLESS STEEL HARDENED, GROUND AND LAPPED
RELIANCE
VALVE BODY OF NAVY BRONZE
SCREWS STAINLESS STEEL LOCKED IN BY SPINNING



Reliance Forged Steel W73 Alarm with Tiltview Water Gage.

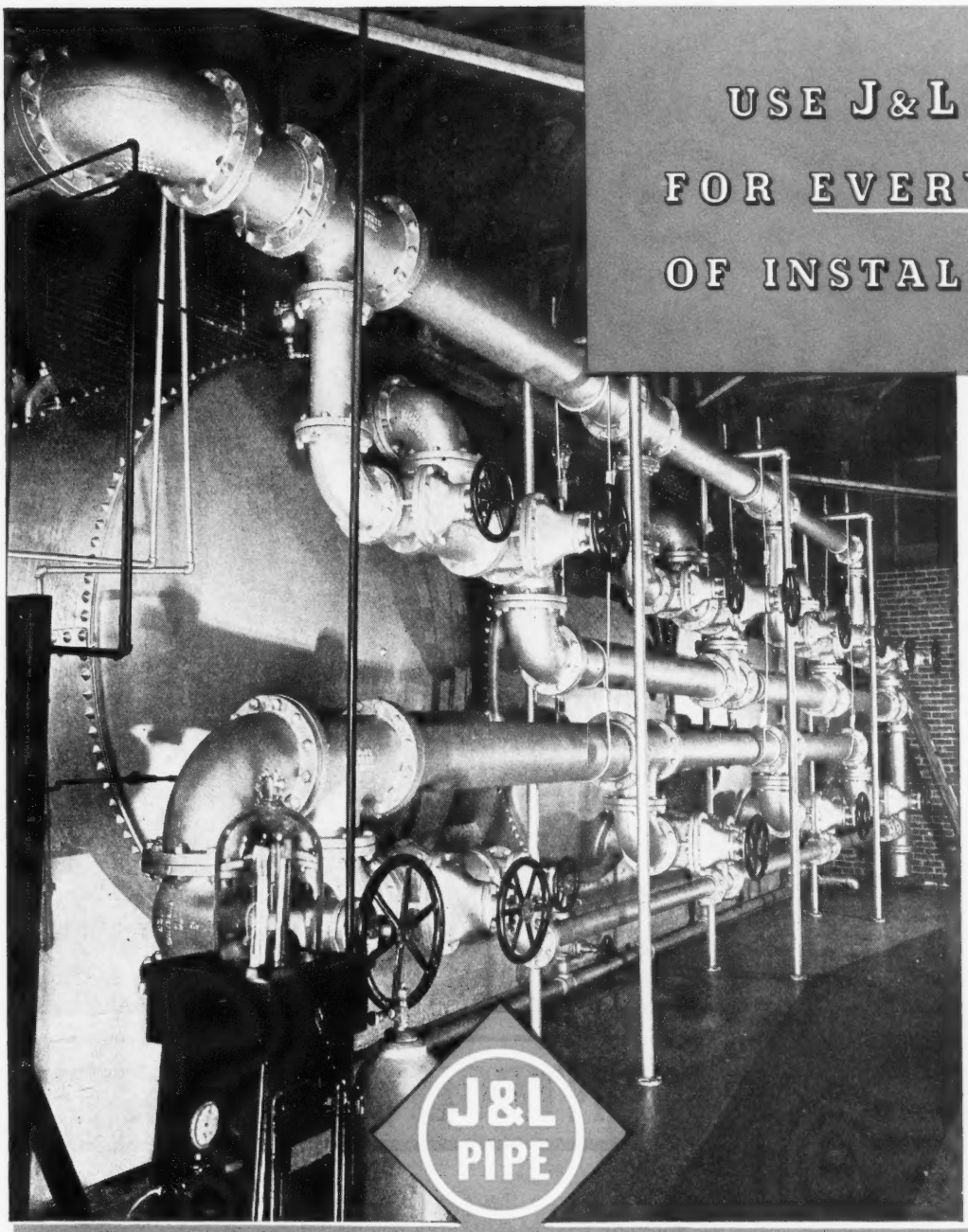
When you need your low water alarm, *you need it*—instantly, surely. Specify Reliance.

THE RELIANCE GAUGE COLUMN CO.
5902 CARNEGIE AVE. CLEVELAND, OHIO

TRADE MARK REG. IN U.S. PAT. OFF.

Reliance

SAFETY WATER COLUMNS



USE J&L PIPE FOR EVERY TYPE OF INSTALLATION

THE J & L LINE
includes welded pipe to 16"O.D., seamless tubular products to 14" O.D., and hot rolled seamless steel boiler tubes from 1" to 6" O.D. inclusive.

Jones & Laughlin steel pipe is in use in all types of buildings all over the country, and users everywhere testify to its satisfactory performance in all types of installations.

Contractors prefer J & L steel pipe because of its many fine qualities. J & L pipe is made from selected steel. It is free from excess scale. It is thoroughly coated to protect it from corrosion and to assure its arrival on the job in good condition. A special process provides uniform and effective galvanizing. Mill threads are accurate and because of its uniform cutting qualities, similar sharp, true threads are cut easily on the job. Sound, accurately tapped couplings add to the ease of installation. Finally, a rigid inspection system is assurance that the uniform high quality of J & L pipe is constantly maintained. Look to J & L for your steel pipe requirements.

J & L manufactures a complete line of steel tubular products, both welded and seamless, including hot rolled seamless boiler tubes.

J&L STEEL

JONES & LAUGHLIN STEEL CORPORATION
AMERICAN IRON AND STEEL WORKS
JONES & LAUGHLIN BUILDING, PITTSBURGH, PENNSYLVANIA
Sales Offices: Atlanta Boston Buffalo Chicago Cincinnati Cleveland Dallas Denver Detroit Erie Los Angeles Memphis Milwaukee Minneapolis New Orleans New York Philadelphia Pittsburgh St. Louis San Francisco
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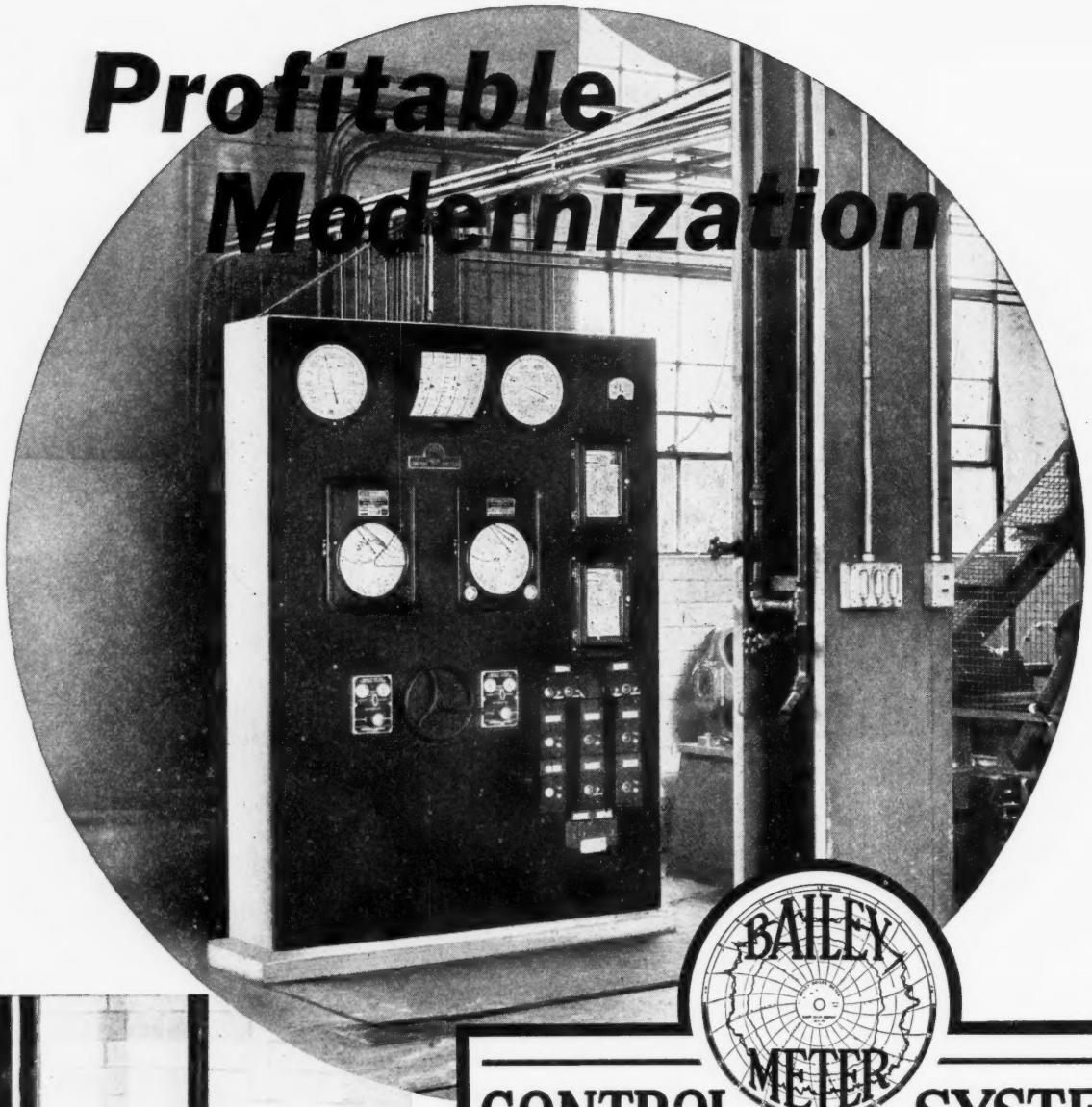
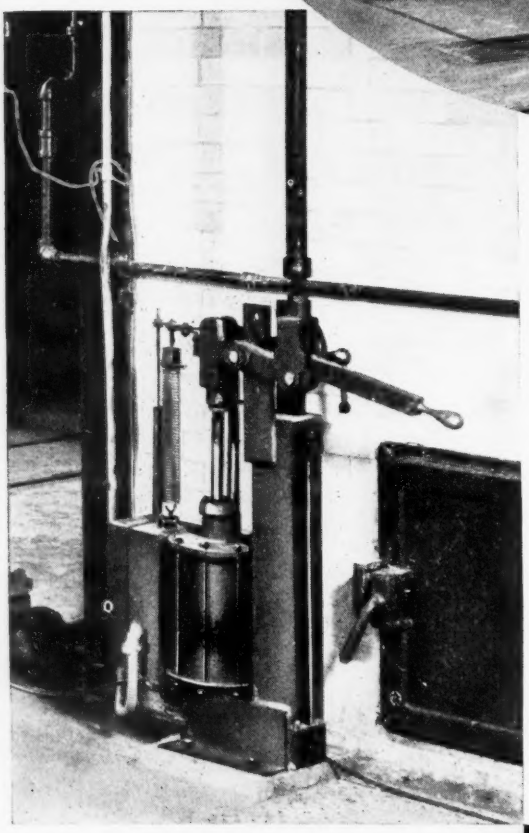
Canadian Representatives: JONES & LAUGHLIN STEEL PRODUCTS COMPANY, Pittsburgh, Pa., U. S. A., and Toronto, Ont., Canada

Profitable Modernization



BAILEY METER CONTROL SYSTEM



Bailey Boiler Control Panel and Air-Operated Control Drive installed in a Mid-Western Chemical Plant.

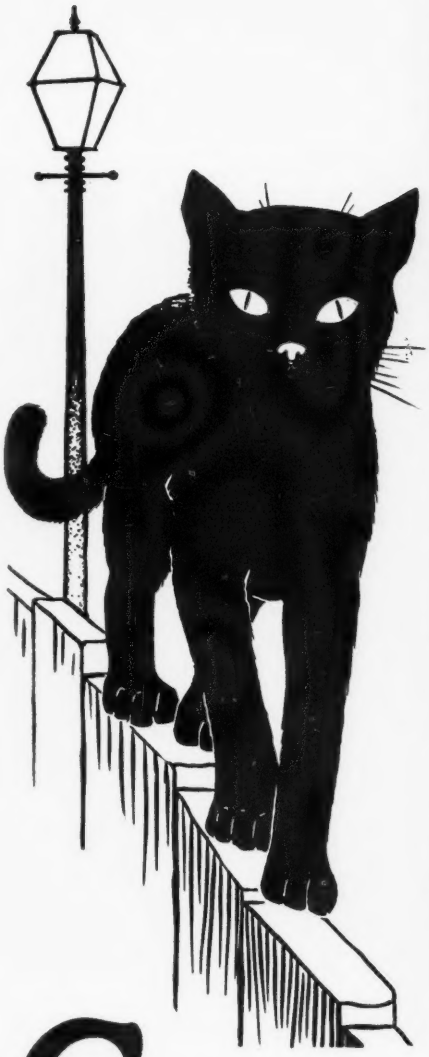
In addition to the purchase of new boilers and modern fuel burning equipment for the revamping of existing units, profitable boiler plant modernization calls for COMPLETE Combustion Control. Without this equipment, losses resulting from inefficient operation may wipe out all hope for profit. With it, you automatically secure test results in everyday operation.

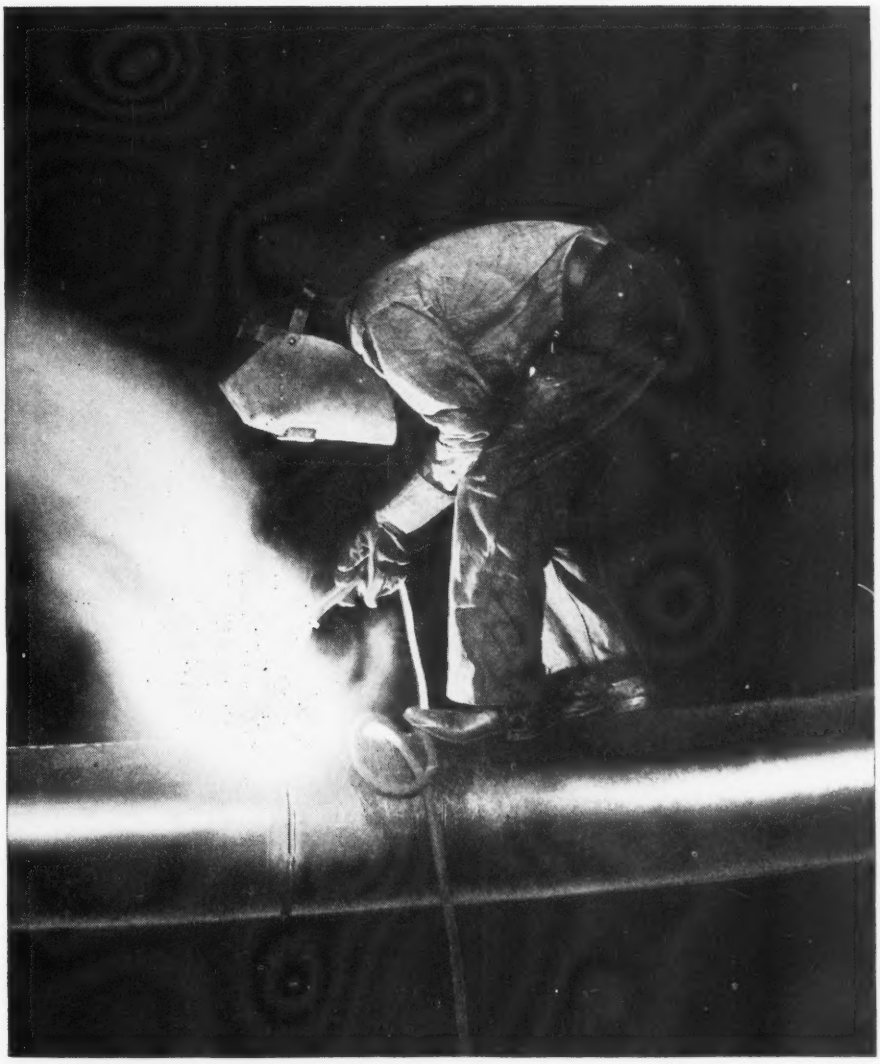
Test results are secured with Bailey Meter Control because it is COMPLETE. It not only maintains steam pressure but also automatically readjusts fuel or air to constantly maintain maximum economy. Constant control of fuel—air ratio and the accurate control of furnace draft reduce furnace maintenance to a minimum. This complete combustion control system is described in Bulletin No.102. Write for your copy today.

BAILEY METER COMPANY
1036 IVANHOE ROAD • CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

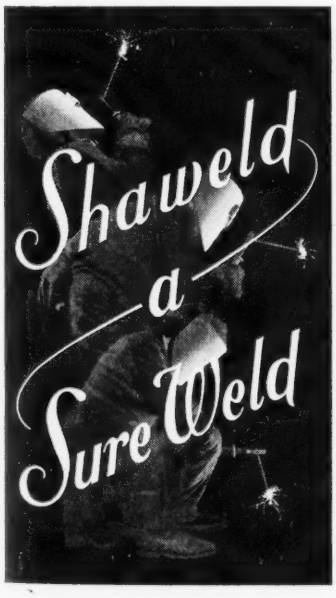
A-14

The **COMPLETE** *Combustion Control System*



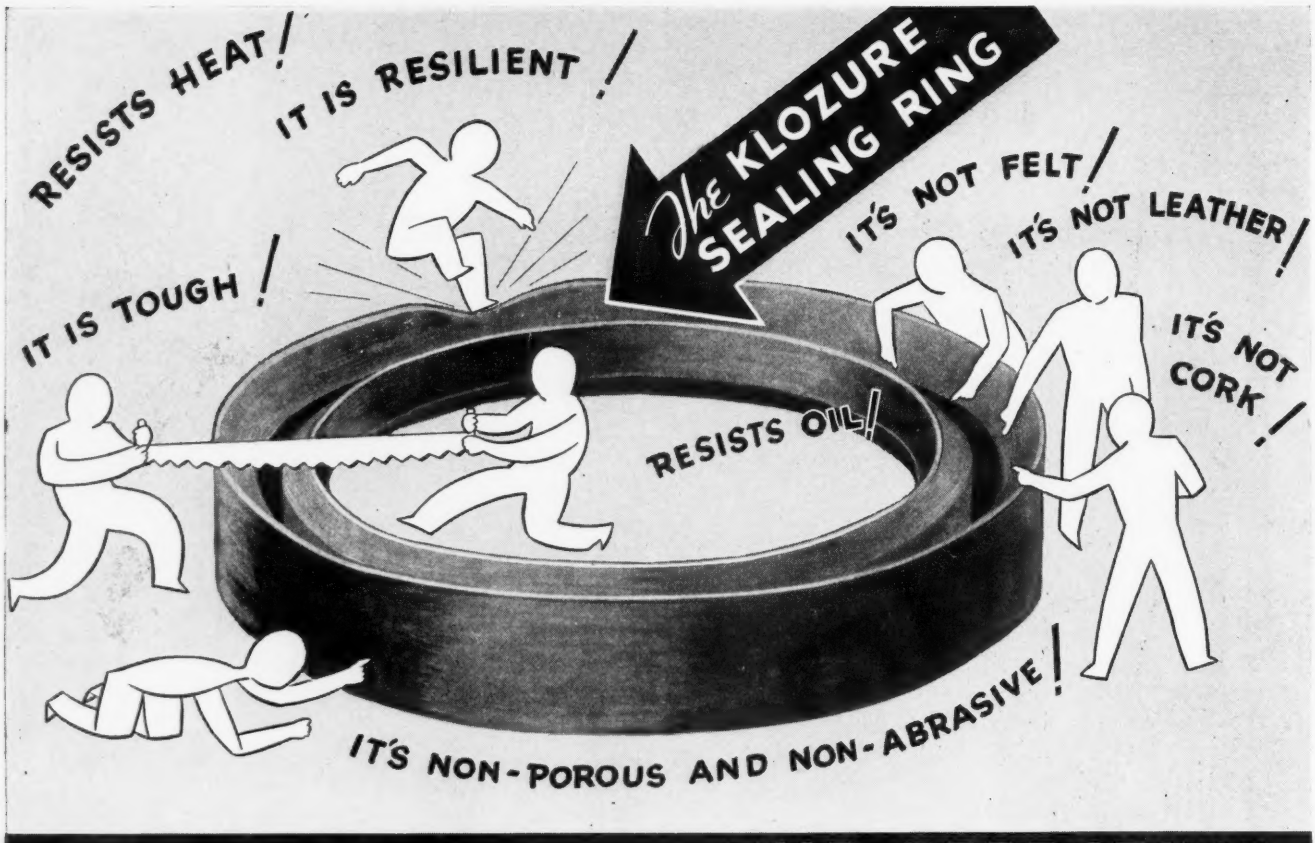


Cat-like Agility
Commendable *but Wasteful*

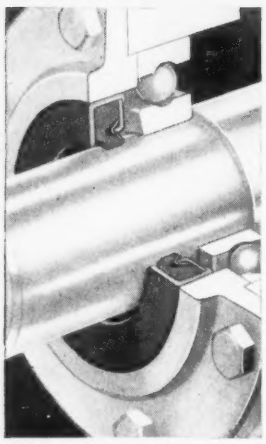


Silly for this welder to balance himself when he could straddle the pipe and save the risk and discomfort of a precarious position. Comparable "absurdities" are far too often "realities" in field welding, thus this same logic is applicable to the question "shall we do it ourselves or have the work Pre-Fabricated by Shawco?" . . . Why take a chance on Quality when all welds, bends, flanges, etc., can be made by experts under ideal conditions. Why jeopardize Economy when the piping can be pre-fabricated in our shops, usually in less time than it takes to get ready to do the same work under adverse field conditions . . . Shaweld Pre-Fabrication Safeguards the Potential Economies of Welding Methods . . . Write for the "Book of Installations" of the Benjamin F. Shaw Co., Wilmington, Del.

SHAWCO



KLOZURE THE EFFECTIVE OIL SEAL



PATENTED

DENSE, grainless, resilient, tough . . . the sealing ring of the Garlock KLOZURE effectively resists oil and heat—and reduces friction to an absolute minimum.

Not leather, cork or felt—this sealing ring consists of an exclusive Garlock compound specially developed in the Garlock laboratories. It is molded to exact sizes—accurate in *every* dimension.

The Garlock KLOZURE is establishing remarkable performance records on all types of equipment. Complete range of sizes. Write for booklet.

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Co. of Canada, Ltd.
Montreal, Que.

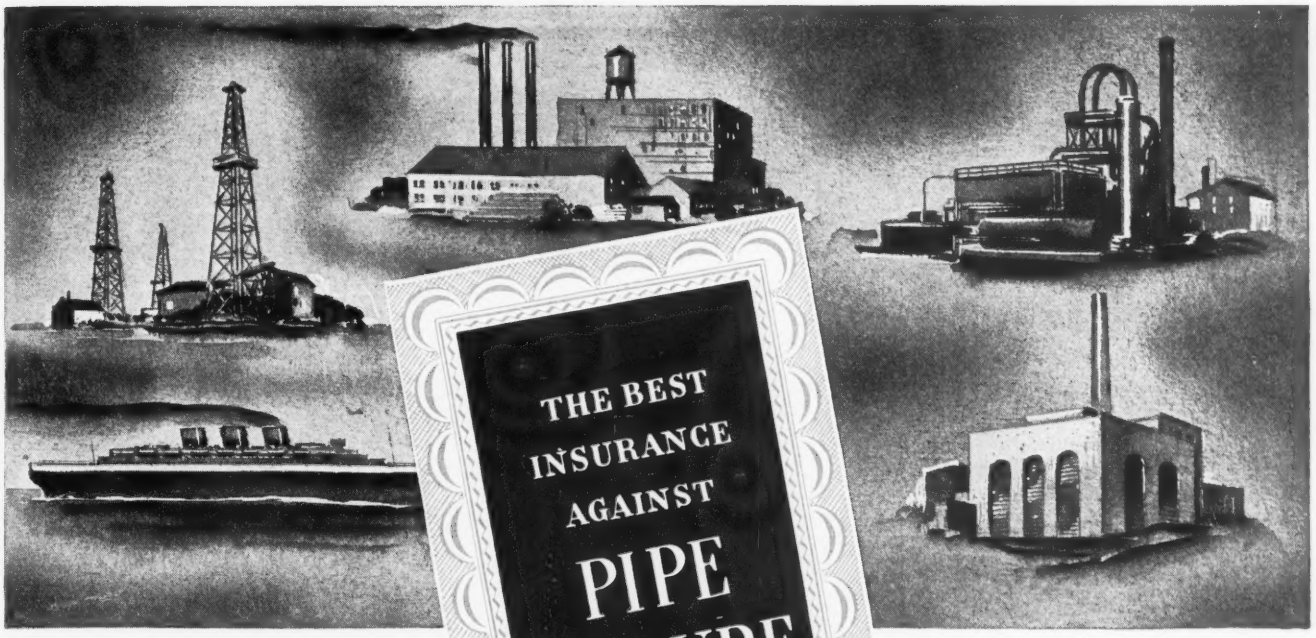
The Adapter

The Spreader

The Sealing Ring

The Case

GARLOCK



No one objects to paying 25 cents for a half-dozen razor blades, even though it is common knowledge that the steel in those blades costs in ingot form only an infinitesimal fraction of a cent. Why?

Those blades do what the steel in the ingot could not do before work was done on it. You pay for the service the steel has been processed to do.

It's the same with Toncan Iron Pipe. Open hearth iron has been alloyed with copper and molybdenum and processed to resist corrosion—and it does to a greater degree than any other ferrous material in its price class. Naturally, it costs more than ordinary pipe, but don't figure it that way. Figure the slight additional cost of the pipe itself as insurance against pipe failure. Then you will quickly realize how slight a premium you are paying for long dependable service—how little you are paying to cut down repair and replacement expense. And don't forget that it costs more to tear out failed pipe and replace it with new than it costs to make the original pipe installation. So the smart thing to do is to install Toncan Copper Molybdenum Iron Pipe in the first place and save money.

REG. U.S. PAT. OFF.
TONCAN
COPPER
MO·LYB·DEN·UM
IRON PIPE

REPUBLIC STEEL

Republic Steel
CORPORATION
GENERAL OFFICES · · · YOUNGSTOWN, OHIO

Triple Acting Non-Return Valves . . . . . .

Plain Non-Return Valves

Automatic Throttle and Engine Stop Valves . .

Emergency Trip Valves
(Electrically Operated)

Pressure Reducing Valves

Pressure Unloading Valves

Altitude Control Valves

Water Reducing Valves

Float Control Valves

Water Control Valves

Water Check Valves

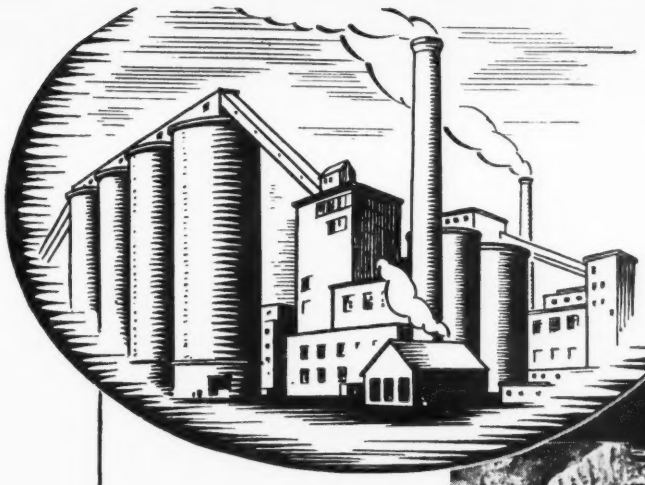
By

GOLDEN-ANDERSON

New Catalog describing these and other G·A· Specialty Valves sent on request

GOLDEN-ANDERSON VALVE SPECIALTY CO.

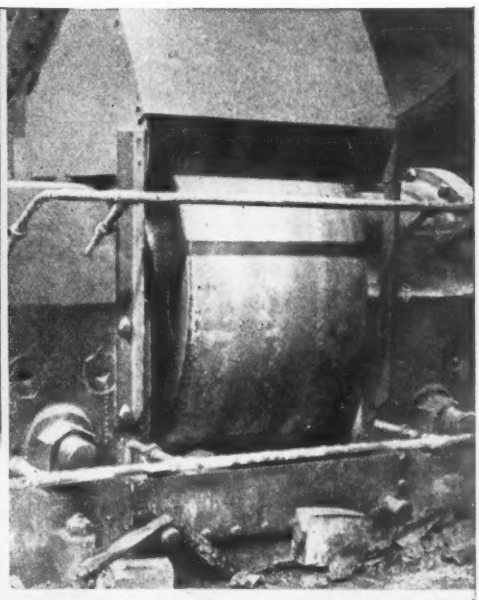
1314 FULTON BLDG. . . . . PITTSBURGH, PA.



Cement Plant saves over $5,000

Left — *Trunnion bearing block after bronze-welding had been partially completed.*

Right — *General view of trunnion bearing blocks which support the huge cement kiln.*



OXWELDING

KEEPS KILN BLOCKS OFF SCRAP PILE

FREEZING of the cooling water in eleven 1500 lb. cast iron trunnion bearing blocks of a 290-ft. cement kiln fractured all the blocks. Replacement would have cost the plant over $5,000.00. Repair seemed hopeless. Oxwelding, however, was employed to restore these blocks. About 8 hours of welding completed each block at a cost of about $35.00 each. New ones would have cost $500.00 apiece.

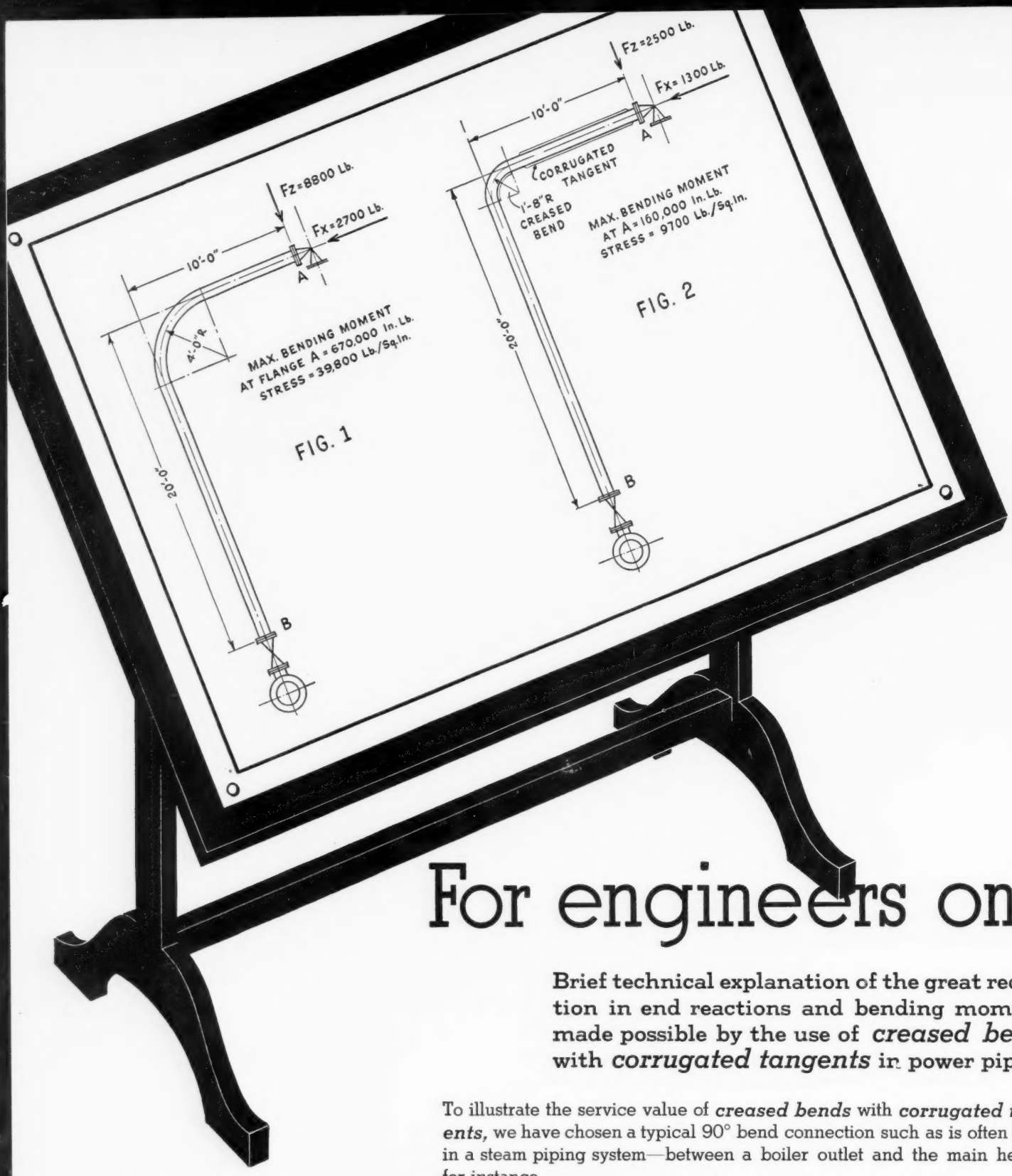
Thus does oxwelding frequently save the cost of new parts—and, what is more important, it often prevents expensive delays and the added penalties which shutdowns always impose.

As a companion tool, oxy-acetylene cutting also saves hours and dollars in the fabrication of many replacement parts. The oxy-acetylene process indeed is the stand-by for quick and low cost repairs to all kinds of equipment.

To secure the manifold advantages and economies of oxy-acetylene welding and cutting, consult freely with Linde's service engineers. Their broad experience is available through Linde Sales Offices located in principal cities throughout the country and at 30 E. 42nd St., New York, N. Y. Address—The Linde Air Products Company, Unit of Union Carbide and Carbon Corporation.

Everything for Oxy-Acetylene Welding and Cutting

LINDE OXYGEN • PREST-O-LITE ACETYLENE • OXWELD APPARATUS AND SUPPLIES FROM PRODUCTS OF UNITS OF UCC UNION CARBIDE AND CARBON CORPORATION LINDE UNION CARBIDE



For engineers only

Brief technical explanation of the great reduction in end reactions and bending moments made possible by the use of *creased bends* with *corrugated tangents* in power piping.

To illustrate the service value of ***creased bends*** with ***corrugated tangents,*** we have chosen a typical 90° bend connection such as is often found in a steam piping system—between a boiler outlet and the main header, for instance.

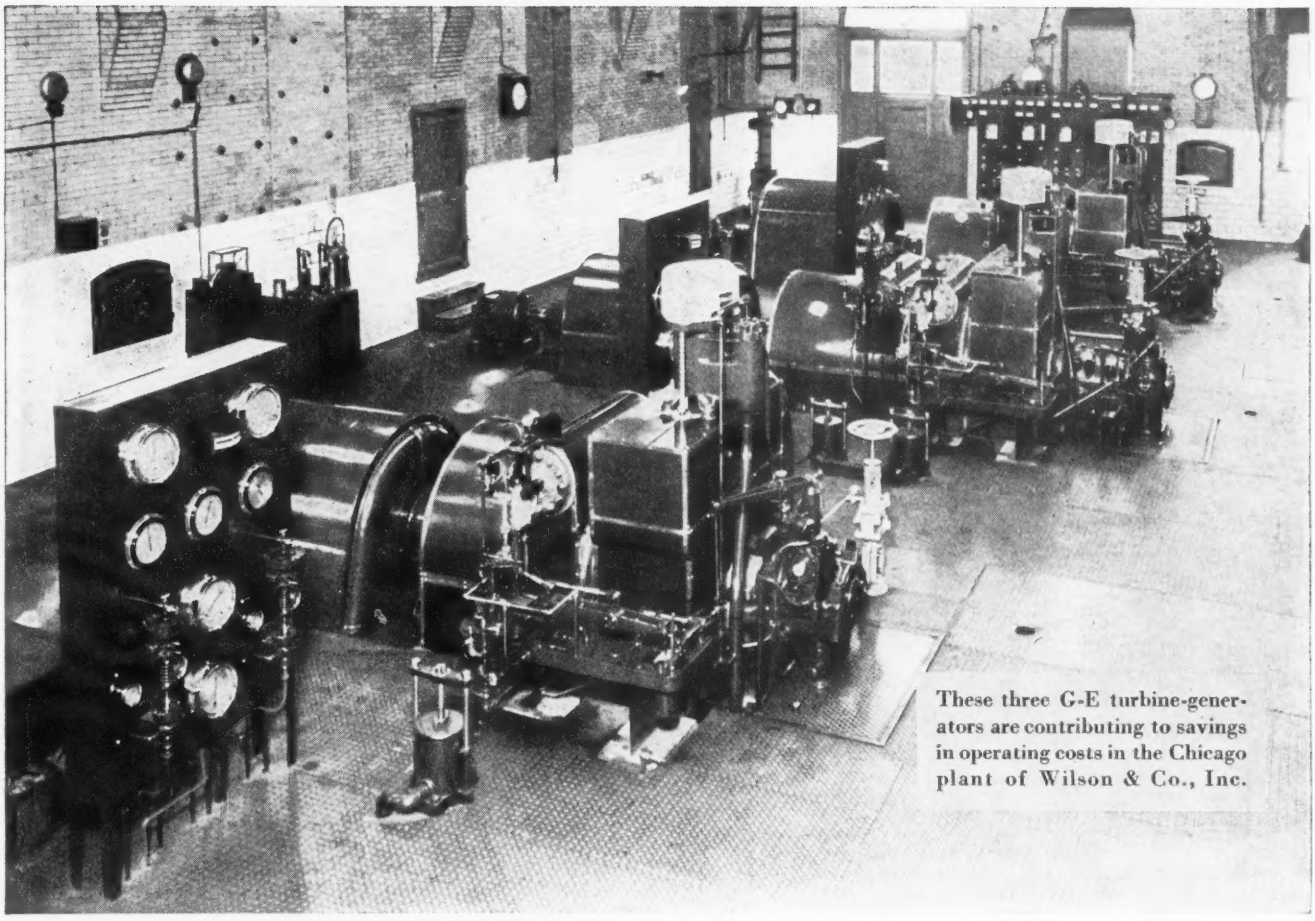
The calculation for end reactions and moments are based on 8", 400 lb. seamless steel pipe and a steam temperature of 700°F. The connections at flanges A and B are assumed to be rigid. Fig. 1 shows the conventional type of connection with a long radius plain bend and smooth tangent. The calculated end reactions are very high and the stress at flange A exceeds the safe working stress. Fig. 2 shows a creased bend with one corrugated tangent. The overall dimensions are the same as for Fig. 1 but the end reactions and bending moment at the joints have been greatly reduced and the maximum stress is well within safe limits.

NEW DESIGN MANUAL

The design of piping for flexibility is a complex problem involving extensive calculations. The **Pittsburgh Piping Design Manual**, just off the press, has been compiled so that engineers may be saved much arduous, time-consuming effort and still be sure of adequate design without the waste of over-safe guessing. If you are an engineer interested in piping design we want you to have a copy of this authoritative book with our compliments. Please use your business stationery and address:

Pittsburgh Piping & Equipment Co.
43rd Street and A.V.R.R., Pittsburgh, Pa.

PITTSBURGH PIPING



These three G-E turbine-generators are contributing to savings in operating costs in the Chicago plant of Wilson & Co., Inc.

Wilson & Co. Obtains Added SAVINGS from By-product Power with G-E TURBINE-GENERATORS

THREE G-E noncondensing turbine-generators installed in 1933 contribute to savings in operating costs at the Chicago power plant of Wilson & Co. They take steam at 385 lb pressure and deliver steam at 3 lower pressures: for operating mechanical-drive turbines and engines, for processing, and for low-pressure heating. At the same time, they efficiently supply electric energy for plant uses.

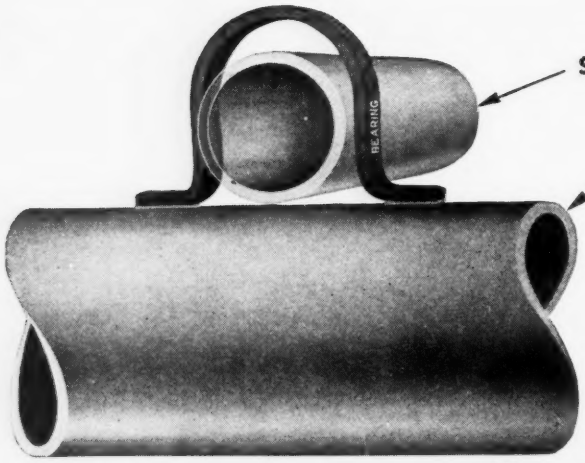
These machines are remarkably flexible in operation. Automatic governing-controls adjust the steam flow at the throttle to meet variations in electrical requirements and steam demands, while they maintain speed and accurately control the extraction-steam pressures.

These turbine-generators are giving dependable service under most exacting conditions.

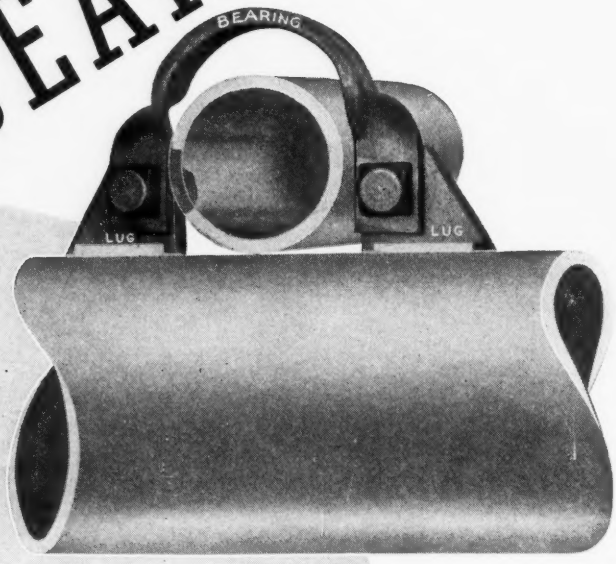
Let our engineers discuss with you the application of turbine-generators to your plant conditions. For information, refer to the nearest G-E sales office, or write General Electric Company, Schenectady, N. Y.

710-190

GENERAL ELECTRIC



WELDED BEARINGS

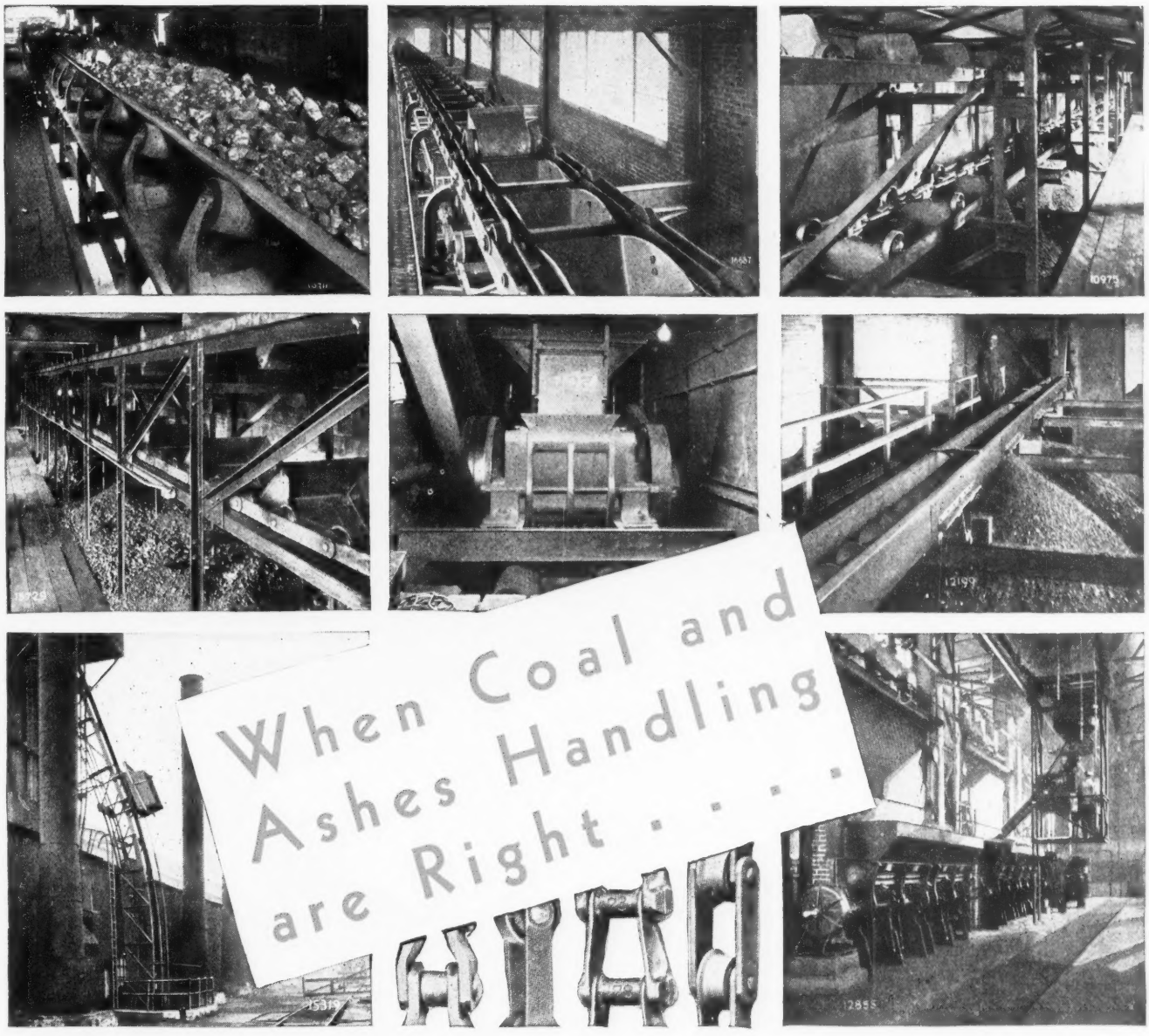


Another
important reason why more than

81% of the soot blowers in all modern steam plants are **DIAMOND**

SOOT Blower Element Bearings welded directly to the boiler tubes eliminate all the causes of ordinary bearing failure in the hottest locations. Being welded, their positions are fixed—they cannot slip. Welding assures maximum heat conduction from the bearings to the relatively cool boiler tubes. There are various types of Diamond welded bearings to suit the different conditions encountered. Welded bearing construction is unique with Diamond. • Write for a copy of the bulletin "More Proof."

DIAMOND POWER SPECIALTY CORPORATION
Detroit, Michigan
DIAMOND SPECIALTY LIMITED
Windsor, Ontario



The ultimate cost of coal cannot be determined until the coal is consumed . . its power utilized . . and the ash residue disposed of. *Handling* that coal from mine to track to power plant to ash pile is a major item in that final cost.

Over 50 years of engineering experience is behind Jeffrey Coal and Ashes Handling Equipment. Jeffrey Belt Conveyors, Pivoted Bucket Carriers, Scraper Conveyors, V-Bucket Conveyors, Spiral Conveyors, Crushers, Bucket Elevators, Skip Hoists, Weigh Larriers, Steel Apron Conveyors, Drag Chain Conveyors, and Chains for Elevating, Conveying and Transmission are installed as *Cost Cutters* from coast to coast.

With the equipment and the engineering experience to put your coal and ash handling on the lowest possible cost basis, whether your plant is small or large, *Jeffrey can show you savings.* Today when labor and material costs are largely unmanageable, power savings are vitally important.

Write for literature covering Jeffrey Coal and Ashes Handling Equipment.

The Jeffrey Manufacturing Co.

932-99 North Fourth Street, Columbus, Ohio

New York	Pittsburgh	Chicago	Denver
Buffalo	Boston	Cleveland	Salt Lake City
Rochester, N. Y.	Scranton, Pa.	Huntington, W. Va.	Birmingham
Philadelphia	Cincinnati	Milwaukee	Terre Haute, Ind.
	Detroit	St. Louis	

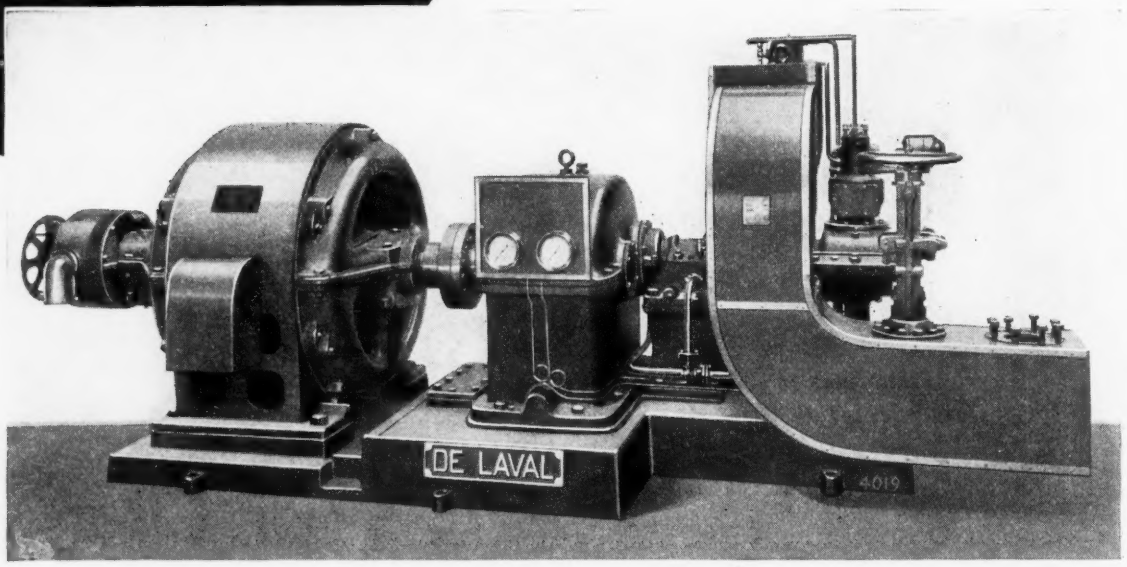
JEFFREY MANUFACTURING COMPANY, LTD., OF CANADA
Head Office & Works, Montreal—Branch Offices: Toronto-Calgary-Vancouver

JEFFREY MATERIAL HANDLING EQUIPMENT

This PRESSURE REDUCER *Makes* POWER

THE DE LAVAL GEARED TURBINE

here shown lets steam down to 5 lb. gage for use in the manufacturing process and in the heating system, and at the same time drives a 250 kw. alternator.



THE turbine uses up only a small fraction of the heat in each pound of steam; there is no waste to condenser, so that only about one-quarter of the cost of the steam is chargeable against power.

Plants which require both power and heat can realize large profits from efficient De Laval turbines properly proportioned to insure economical heat balance.

De Laval turbines embody recent improvements in metallurgy and heat treatment of materials, in streamlining of steam passages, in better design of, and materials for, wheels and buckets, and in better governing arrangements. They are adapted to use steam at the highest pressures and temperatures.

•

The De Laval engineers have had extensive experience in the design of power equipment to meet the special requirements of industrial plants and will supply engineering data and estimates, or assist in the analysis and solution of your individual problem, if requested.

8185

DE LAVAL STEAM TURBINE CO. · TRENTON, N. J.

Manufacturers of Steam Turbines, Centrifugal Pumps, Propeller Pumps, Rotary Displacement Pumps, Centrifugal Blowers and Compressors, Worm Gears, Helical Speed Reducing Gears, Hydraulic Turbines, Flexible Couplings and Special Centrifugal Machinery. Sole Licensee of the Bauer-Wach Exhaust Turbine System.

Smooth

Silent ... Efficient ... Economical

SMOOTH . . . It is practically vibrationless in operation, due to the unique and extremely accurate tie-up between Motor, Gears, Shafts and Bearings.

SILENT . . . It is totally enclosed, precision aligned and operates in a bath of cool, clean oil.

EFFICIENT . . . It transmits the maximum power of the motor through the reducing gears and delivers the maximum horsepower at the driving end of the shaft.

ECONOMICAL . . . It operates day in and day out with the very minimum of attention — always at a high efficiency; and both its operating and maintenance costs are so low as to be almost unbelievable.

Of course, the Philadelphia MotoReduceR offers other advantages, such as, *Compactness* (Space Saving) — *Ease of handling and installing* — and extremely *neat appearance.* Further, it is available in both horizontal and vertical drives.

Write us and learn why hundreds upon hundreds of these Combination Units are used in almost every branch of industry.

Philadelphia
MOTOREDUCER

PHILADELPHIA GEAR WORKS

Industrial Gears and Speed Reducers

Main Office and Plant
Erie Avenue and G Street, Philadelphia, Pa.

Branch Sales and Eng. Offices
New York and Pittsburgh

One thing is sure—

YOUR EQUIPMENT MUST EARN DIVIDENDS

Illustration shows two Fuller Rotary Two-Stage Compressors; one serving a pneumatic conveyor, the other furnishing air for slurry agitation in a modern cement plant. Each has an actual delivery of 800 CFM and is compressing to 75 pounds.

MORE than ever before, management must be alert to present day conditions . . . conditions that are changing from day to day. Costs must be more closely analyzed, equipment that is wasteful or obsolete must be replaced by modern up-to-date machinery or methods to meet present demands. Modernization is the answer, and the engineer or superintendent who does not keep abreast, or a little ahead of the fast changing pace, will find himself losing business to those in his field who do.

Shorter hours, higher wages, higher taxes, and increased cost of raw materials will all cut into profits. Earning of dividends will depend mainly upon a highly efficient, modern plant . . . successful management. Will your equipment produce efficiently so that you can profitably compete with the sharp competition encountered today.

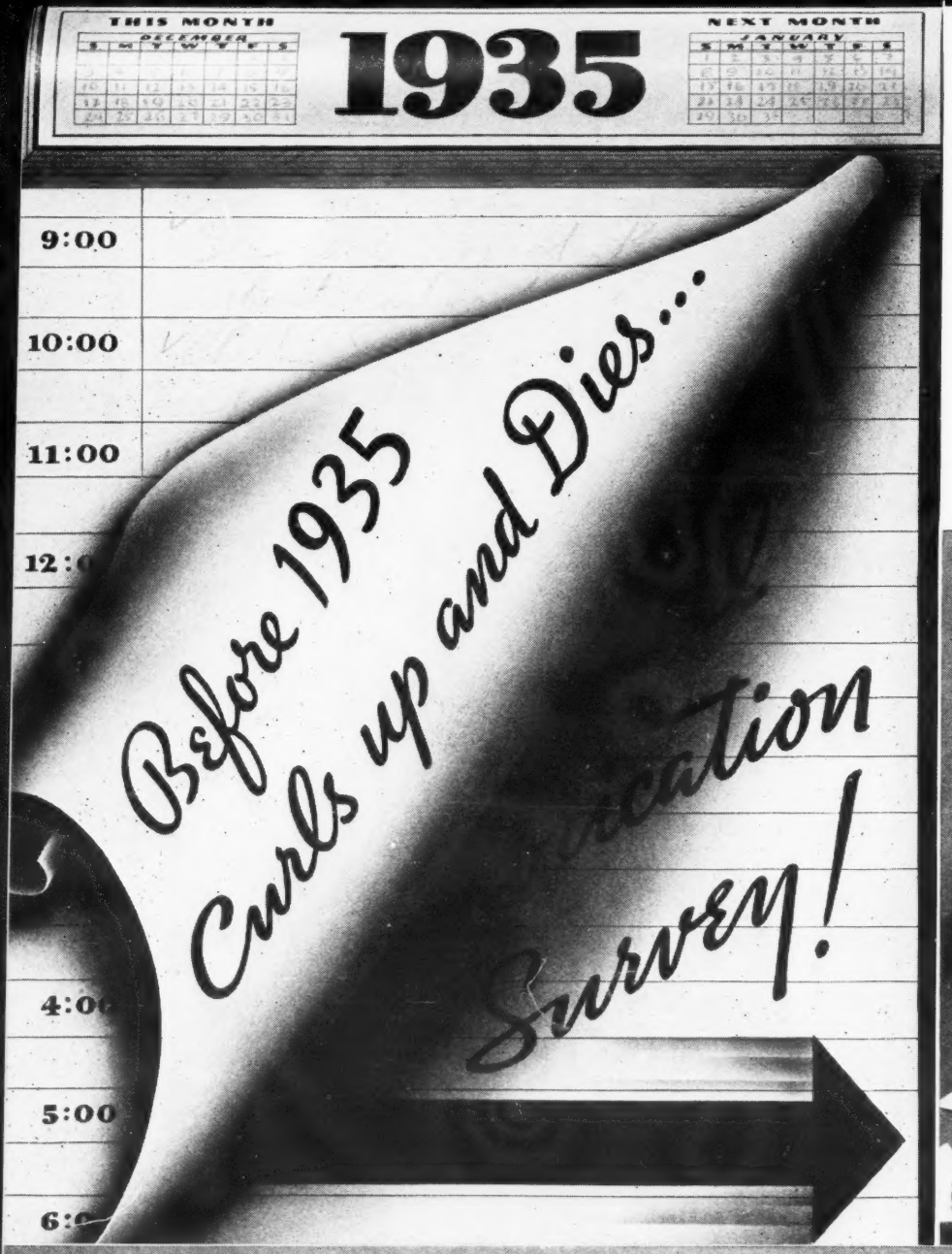
Fuller Rotary Compressors are modern . . . there is a type to meet your particular requirements. It will be to your advantage, possibly mean dividends, to investigate these modern compressors and the advantageous conditions under which they can be installed to obtain these savings. Simply write for Bulletin C-3A, which gives detailed information on this equipment.

Fuller Company
CATASAUQUA, PENNA., U. S. A.

Chicago: 1118 Marquette Bldg.
San Francisco: 564 Market Street

WRITE FOR
THIS BULLETIN

C-1



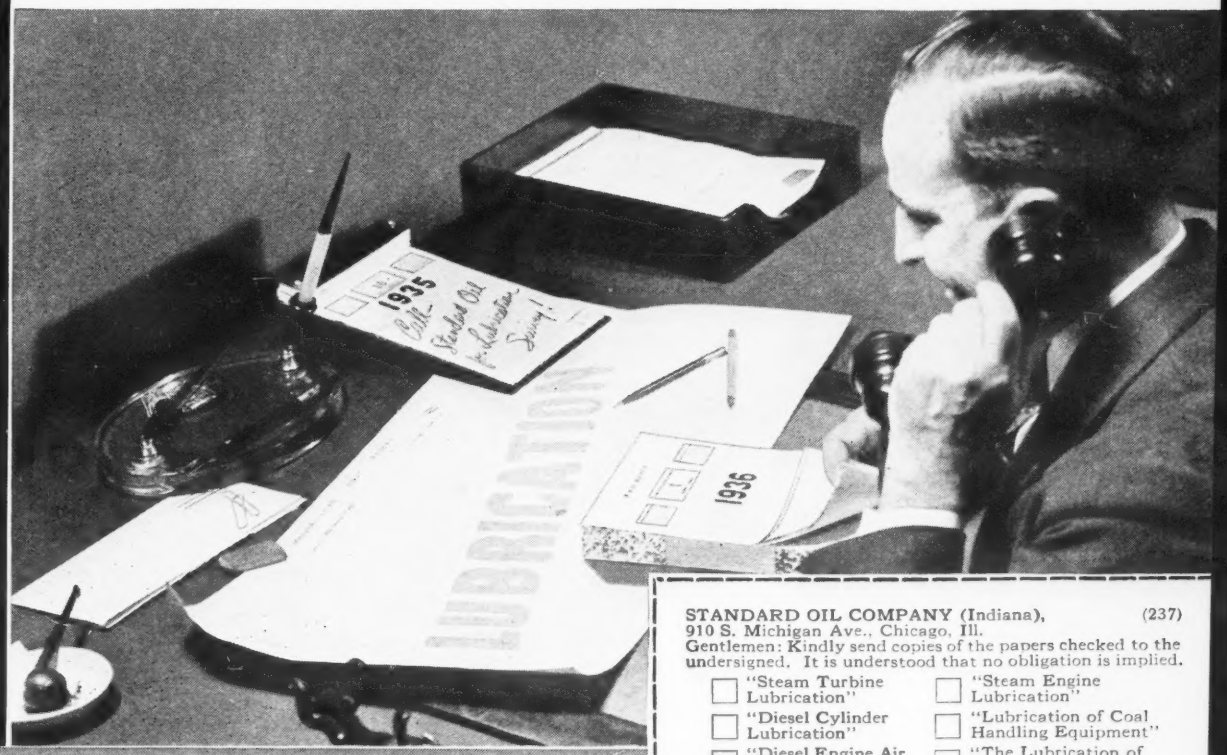
Do what this man is doing!

He has been thinking of how much lubrication cost him in 1935. He has figured out what he spent for repairs and labor due to lubrication trouble, what he lost from idle machine time. He hasn't forgotten that all these losses must be included in determining *total* lubrication costs.

Now he has turned his attention to 1936. He wants to reduce next year's lubrication costs. So he is calling his local Standard Oil office.

Call your local Standard Oil office and ask a Standard Oil Engineer to look over your plant to determine where you can save. His practical experience has enabled him to make large savings for others, often merely through suggestions on lubrication methods or use. There is no obligation whatever.

Copr. 1935, Standard Oil Co.



STANDARD OIL COMPANY (INDIANA)

CORRECT LUBRICATION

STANDARD OIL COMPANY (Indiana), (237)
910 S. Michigan Ave., Chicago, Ill.
Gentlemen: Kindly send copies of the papers checked to the undersigned. It is understood that no obligation is implied.

- ☐ "Steam Turbine Lubrication"
- ☐ "Steam Engine Lubrication"
- ☐ "Diesel Cylinder Lubrication"
- ☐ "Lubrication of Coal Handling Equipment"
- ☐ "Diesel Engine Air & Fuel Cleaning"
- ☐ "The Lubrication of Diesel Air Compressors"
- ☐ "Diesel Engine Bearing Lubrication"
- ☐ "The Lubrication Engineer—His Value to You"

Name .....
Position .....
Company .....
Address .....
City ..... State .....

-and an Extra Ounce *for Good Measure*

SEVENTY years ago, in Nathaniel Jenkins' time, store-keepers commonly gave customers a little more than they paid for. "Good measure", it was called. But, actually, that "extra-measure" was added to please and hold buyers.

In making his revolutionary composition disc valves, Nathaniel Jenkins applied the store-keepers' secret of holding customers. He made his valves better than good enough. He put into them an extra-measure of quality that made a "Jenkins" last longer and work better than a buyer would expect. It was good business. The fame of Jenkins Valves spread to the far corners of the world. Buyers became permanent customers who would have no other make.

Our reputation is built upon this "extra measure of quality" policy established by Nathaniel Jenkins over seventy years ago. Users, frequently writing us tributes such as: "I have been using your valves for the past 35 years and would rather have them at double the cost of any other," make us proud that we have never deviated from it. We are determined that Jenkins Valves shall always return to the buyer an extra-measure of efficient, economical service.

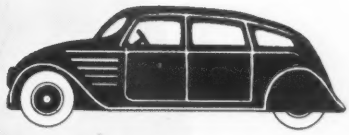
Jenkins Bros

JENKINS BROS., 80 White Street, New York, N. Y. 510 Main Street, Bridgeport, Conn.; 524 Atlantic Avenue, Boston, Mass.; 133 No. Seventh Street, Philadelphia, Pa.; 822 Washington Boulevard, Chicago, Ill.; JENKINS BROS., Ltd., Montreal, Canada; London, England.

JENKINS VALVES · SINCE 1864 · BRONZE · IRON · STEEL

Do You Still Judge CO_2 RECORDERS by "GAS BUGGY" STANDARDS

1901



1936

Some Advancement since this Model! —In both Automobiles and CO_2 Recorders

?

Judge CO_2 Recorders by the "'36 Models" too!

Good old pre-war days of one-lunged gas buggies that sputtered and smoked and busted along at 12 miles an hour! It's a long, long way from those old high-wheelers of 1901 to the stream-lined marvels of 1936;—and it's a long way, too, that CO_2 Recorders have journeyed on this uphill path of progress since 1901.

The automobile has had many problems but the CO_2 Recorder was handed the toughest assignment ever given to an industrial instrument. It had to take the hot, dirty, corrosive flue gases—clean them and filter out all soot—draw in and trap the gas sample—measure it accurately—all the while controlling temperature and pressure—absorb the CO_2 and record the percentage of CO_2 on a 24 hour chart. A half dozen men working in shifts would wear themselves out trying to do the job of an automatic CO_2 analyzer.

Water operation and the Orsat principle has been the answer to this tough assignment. The flow of water provides a powerful reliable suction of the gases and it operates the entire analyzing section without a single moving part—no friction except fluid friction! Much of the recorder trouble in the early days was with clogged and corroded lines, but Hays porous refractory soot filters have been developed to such a high efficiency that soot cannot enter the gas lines. The Hays water-cooled condenser trap chills the hot gases, precipitating and removing corrosive elements. The same water then controls temperature and pressure variations and keeps the analyzing parts washed clean.

By specializing in the combustion instrument field since 1901; by refining the sound fundamental accuracy of the Orsat principle; and by developing the smooth reliability of water operation, Hays has kept pace with the modern automobile.

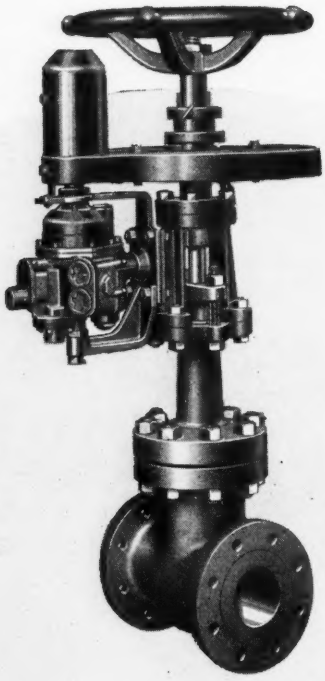
If you want the latest information on the "36 models" in CO_2 Recorders, then write at once for Bulletin PRA35.

THE HAYS CORPORATION

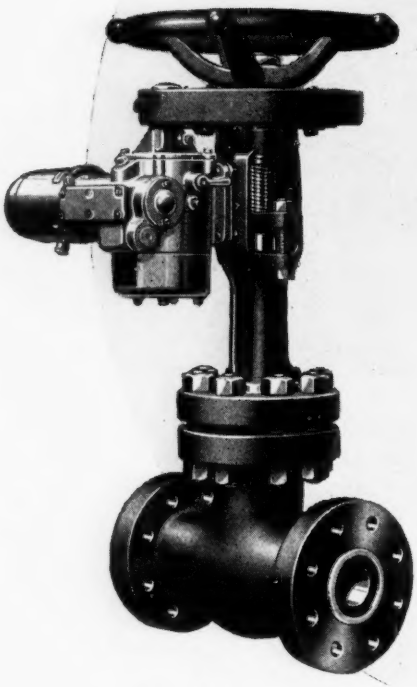
COMBUSTION · INSTRUMENTS SINCE 1901 ·

MICHIGAN CITY, INDIANA

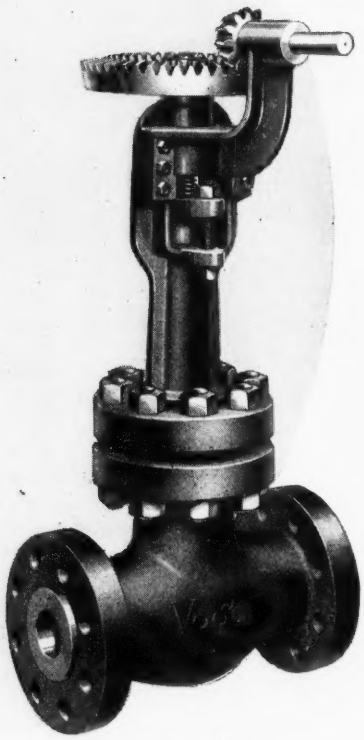
REMOTE CONTROL



Drop forged steel Gate Valve operated by Air Motor.



Electric Motor operated drop forged steel Slide Valve. D. C. or A. C. Motors as specified.



Drop forged steel Globe Valve arranged for hand operation. Bevel or spur gears furnished.

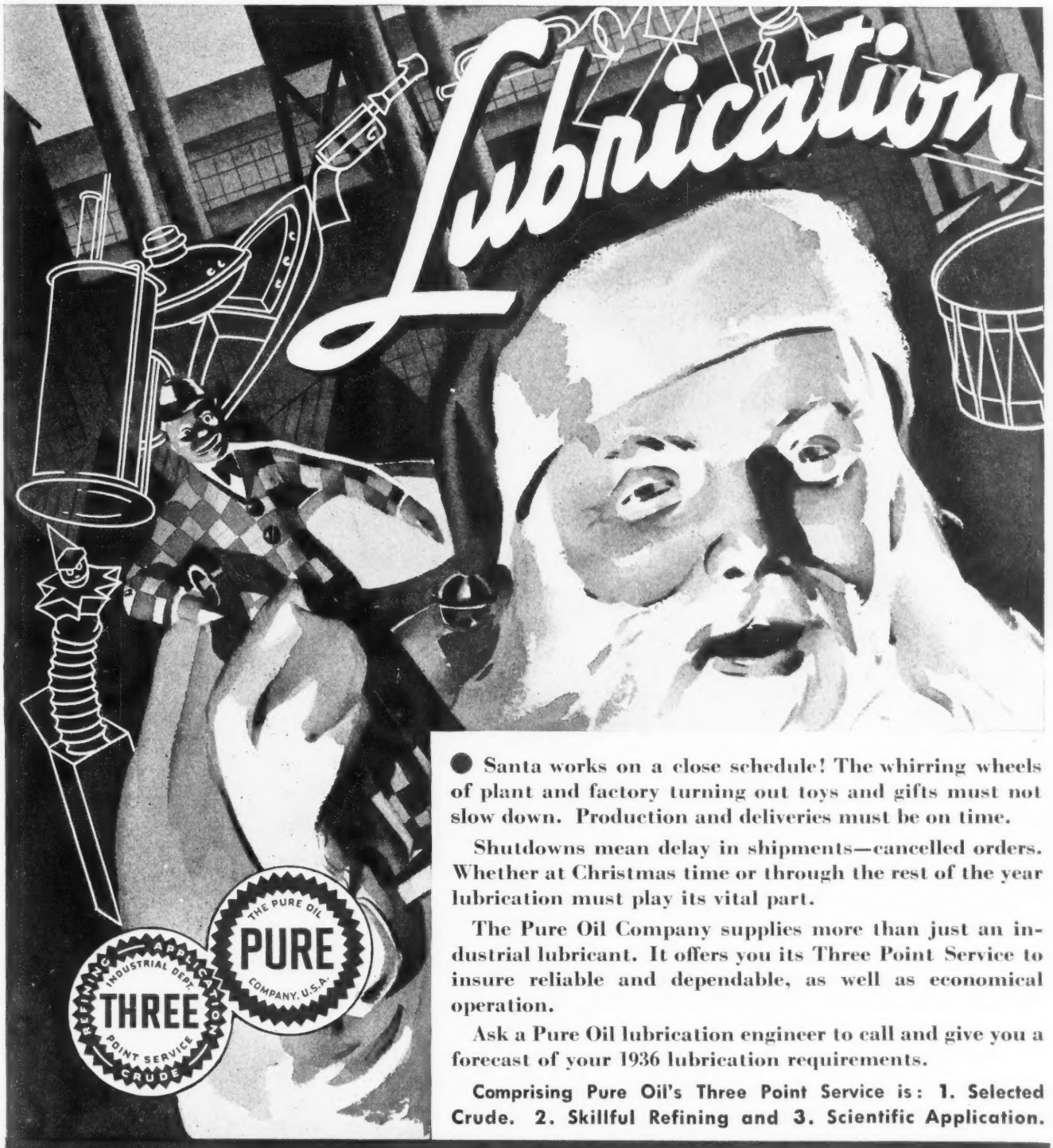
Vogt Globe, Gate and Slide Valves, intended for remote control with Electric Motor, Air Motor or hand operation, are available in sizes from 1½" to 4" in Series 30, 60, 90 and 135 inclusive.

DROP FORGED **Vogt** STEEL VALVES

HENRY VOGT MACHINE CO., Inc. LOUISVILLE, KENTUCKY

NEW YORK CHICAGO PHILADELPHIA CLEVELAND CINCINNATI KANSAS CITY DALLAS

BACK OF IT ALL IS • • •



● Santa works on a close schedule! The whirring wheels of plant and factory turning out toys and gifts must not slow down. Production and deliveries must be on time.

Shutdowns mean delay in shipments—cancelled orders. Whether at Christmas time or through the rest of the year lubrication must play its vital part.

The Pure Oil Company supplies more than just an industrial lubricant. It offers you its Three Point Service to insure reliable and dependable, as well as economical operation.

Ask a Pure Oil lubrication engineer to call and give you a forecast of your 1936 lubrication requirements.

Comprising Pure Oil's Three Point Service is: 1. Selected Crude. 2. Skillful Refining and 3. Scientific Application.

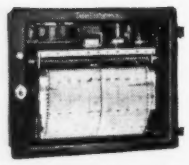
THE PURE OIL CO.

U. S. A.

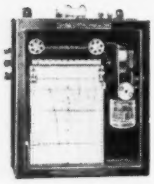
PRODUCERS, REFINERS, MARKETERS OF A COMPLETE LINE OF PETROLEUM PRODUCTS

MINNEAPOLIS-HONEYWELL REGULATOR CO. 1885-1935 125 YEARS OF PROGRESS 1860-1935 THE BROWN INSTRUMENT CO.

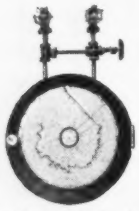
EFFECTIVE RESULTS IN Measurement and Control



Potentiometer Pyrometers

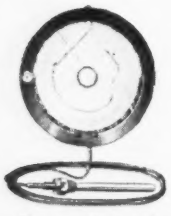


Millivoltmeter Pyrometers



Electric and Mechanical Flow Meters

Co_2 Meters



Thermometers and Pressure Gauges

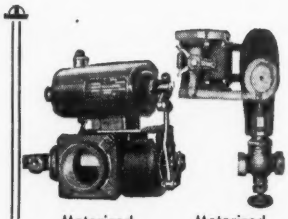
Automatic Controls

Are Achieved Only As Related Equipment is Scientifically Coordinated

Regardless of the size or complexity of your measurement and control problems, Brown Instruments and Minneapolis-Honeywell controls provide a dependable and unified system wherein each unit is accurately coordinated with operating conditions — assuring increased efficiency and economical operation.

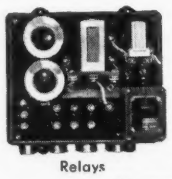
This is made possible because your problems of recording, indicating and controlling temperatures, pressures, flows, liquid levels, humidity and other factors are constantly reported to our research and design engineers by our nation-wide field organization.

When you look for instruments best suited for your requirements, call in one of these engineers who knows your work and is backed by an organization combining 125 years of experience in pioneering and perfecting industrial measuring and automatic control equipment. There is no obligation. For information, write Brown Instruments, a division of Minneapolis-Honeywell Regulator Co., 4490 Wayne Avenue, Philadelphia, Pa. Offices in all principal cities. Canadian factory—117 Peter Street, Toronto, Canada.

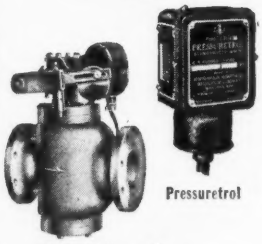


Motorized Adjustable Orifice Valve

Motorized Globe and Butterfly Valve

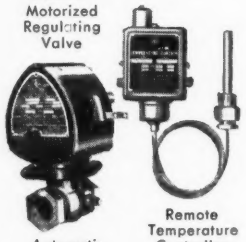


Relays



Pressuretrol

Motorized Regulating Valve

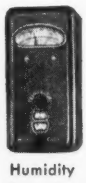


Automatic Shutoff Gas Valve

Remote Temperature Controller

Protectoglow Combustion Safety Controller

Thermostats

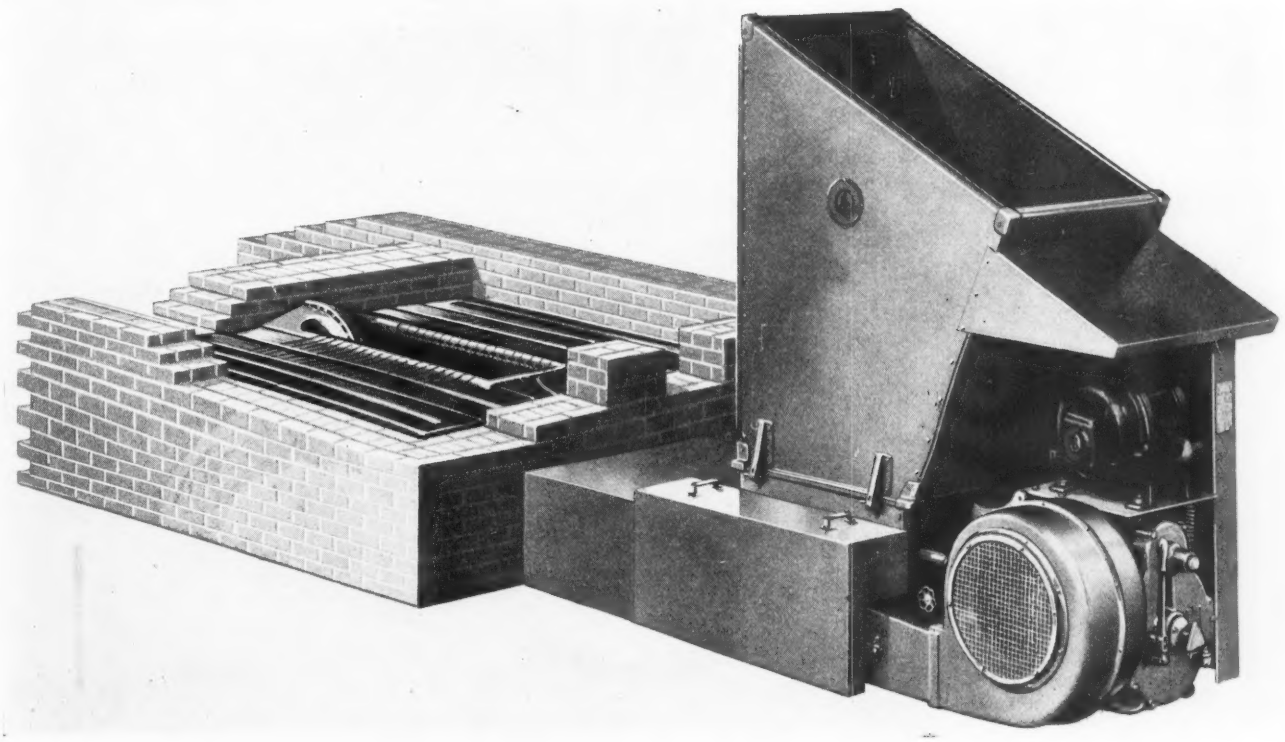


Humidity Controller

BROWN INSTRUMENTS AND MINNEAPOLIS-HONEYWELL CONTROL SYSTEMS

To Measure and Control is to Economize

Iron Fireman **POWERAM** *Stoker*



Standard of Value in the Power Field

HERE are the features of the Iron Fireman *Poweram* stokers that have made these machines so popular with power plant men:

Iron Fireman stokers can be purchased on an FHA loan or on an easy Iron Fireman monthly payment plan.

1. Worm-Distributor Feed. Coal is conveyed *to* the firebox by a worm. Coal is distributed *in* the firebox by pusher blocks. Thus, coal is delivered to the combustion chamber in a loose, free-burning condition and is then distributed evenly over the retort.

2. Powerful Operating Mechanism. The *Poweram* stoker is driven by a patented Iron Fireman transmission, powerful, efficient, quiet. It is a continuous feed transmission operating smoothly and steadily.

3. Ample Air Supply. Air supply is derived from a centro-balanced rotor fan. This fan has sufficient capacity to meet all operating requirements efficiently.

4. Automatic Air Volume Regulation. Regardless of fuel bed conditions or the type of coal used, the Iron Fireman *Volumeter* supplies exactly the amount of air needed for perfect combustion. As every power man knows, this feature is an outstanding contribution to automatic stoker firing.

5. Heavy Duty Construction. *Poweram* stokers are built for continuous service in plants where firing loads put equipment to the supreme test. In the fine quality of materials, in accuracy of construction, and in armor plate ruggedness, Iron Fireman *Poweram* stokers rank among the sturdiest and most dependable mechanisms ever produced.

6. Advantage of Installation. *Poweram* stokers can be installed at various distances from the boiler to give ample clearance for fire cleaning, and they can be secured in bunker models that feed direct from bin to boiler.

7. Responsibility to Users. The Iron Fireman Manufacturing Company makes nothing but coal burning equipment. Its entire resources and energies are concentrated in this field in the furtherance of two policies: (1) To make the best possible stoker. (2) To insure users continuous and satisfactory service. Responsibility to users has always been and will always be a feature of this company's operation.

●

Full information on Iron Fireman *Poweram* stokers will gladly be supplied. A further service, that of making a free survey of your boiler room and a factual report on what Iron Fireman can do for you, also will be made by competent engineers at your request. Iron Fireman Manufacturing Co., Portland, Oregon; Cleveland; Toronto. Dealers everywhere.

FOR HEAVY DUTY SERVICE IN POWER AND HEATING BOILERS UP TO 300 H. P.

IRON FIREMAN

AUTOMATIC *Self Regulating* COAL FIRING

IRON FIREMAN MFG. CO.
3230 W. 106th St., Cleveland, Ohio

☐ Please make boiler room survey

☐ Send literature

OUR CATALOG IS FILED IN SWEET'S

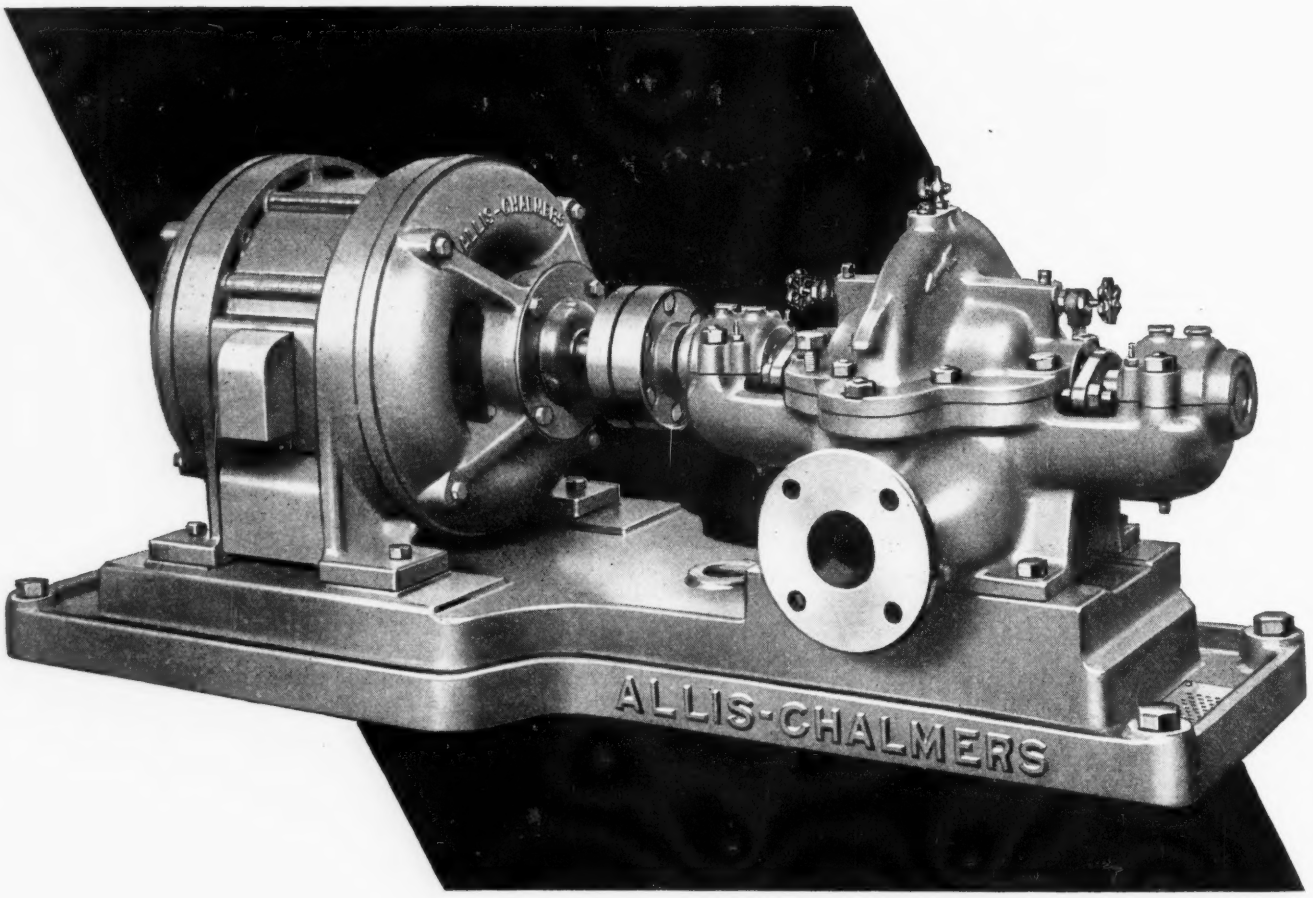
Name.....

Address.....

A Good Pumping Unit

For Average Requirements—

30 to 50,000 gpm.



ALLIS-CHALMERS Centrifugal Pumping Units have a fine and sturdy appearance and they perform as well as they look. They are backed by half a century of experience in engineering and building good centrifugal pumps. You can depend on Allis-Chalmers Units.

The Type "S" unit, shown above, is one of the most widely used units for general purpose pumping. This type will handle capacities from 30 to 50,000 gallons per minute. It is an improved double-suction, split-casing, bronze-fitted, horizontal-shaft pump designed for long service and high efficiency at a reasonable cost.

Type "S" pumps are described in Bulletin 1650. Write for a copy.

Centrifugal Pumps

The Allis-Chalmers line consists of low, moderate, and high head single stage pumps of 1″ to 72″ discharge, multi-stage pumps for working pressure up to 1500 pounds, high efficiency paper stock pumps, and pumps for special applications.

ALLIS-CHALMERS

— Allis-Chalmers Manufacturing Company, Milwaukee, Wisconsin, U.S.A. —

It Never Dries Out!

SEALS METAL JOINTS

• and keeps them permanently tight!

UNEQUALLED FOR PREVENTING LEAKS

Gaskets — pipe flanges — pipe joints—pressed plates and covers —joints of all kinds—can now be made leak-proof under practically all conditions, with ease and permanence that marks Fostoria TiteSeal the new leader and unquestionable superior of all joint sealing compounds. Try it!

There is nothing else like it. Fostoria TiteSeal is new. It is different. This sensational development provides the perfect material for practically every joint sealing job. It will not harden, crack, shrink or crumble. Steam, water, oil, gas, liquids, and vapors will not affect the plasticity and tight gripping qualities of this permanent sealing compound. It is as easy to remove as it is to apply. Simply spread on or wipe off. But—see for yourself. Ask for a free trial package and discover all of the many exclusive advantages Fostoria TiteSeal provides for you.

TITE fostoria SEAL

FREE TRIAL PACKAGE

THE FOSTORIA PRESSED STEEL CORP.
Fostoria, Ohio

Without obligation, send me free trial package and more information about Fostoria TiteSeal.

Name_____

Address_____

City_____ State_____

COCHRANE HOT PROCESS SOFTENERS & DEAERATING HEATERS

are saving millions of dollars annually for boiler plants

by preventing

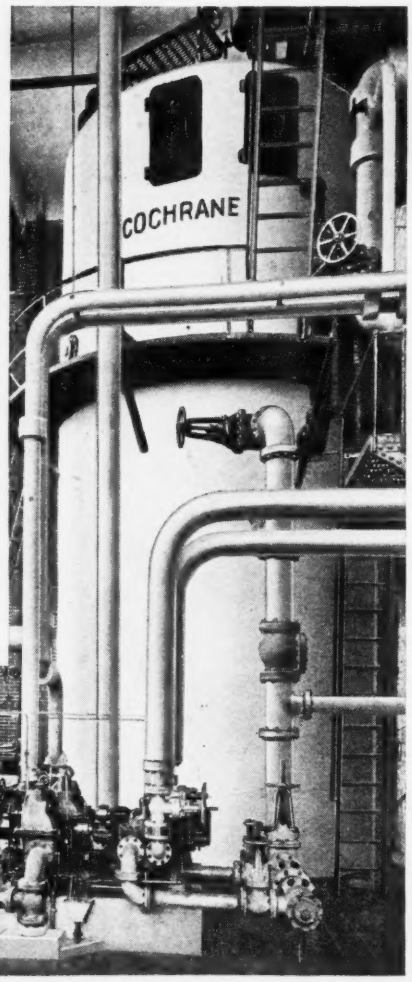
SCALE: by removing chiefly calcium and magnesium, and by giving the water such chemical characteristics that the remaining mineral solids do not form scale.

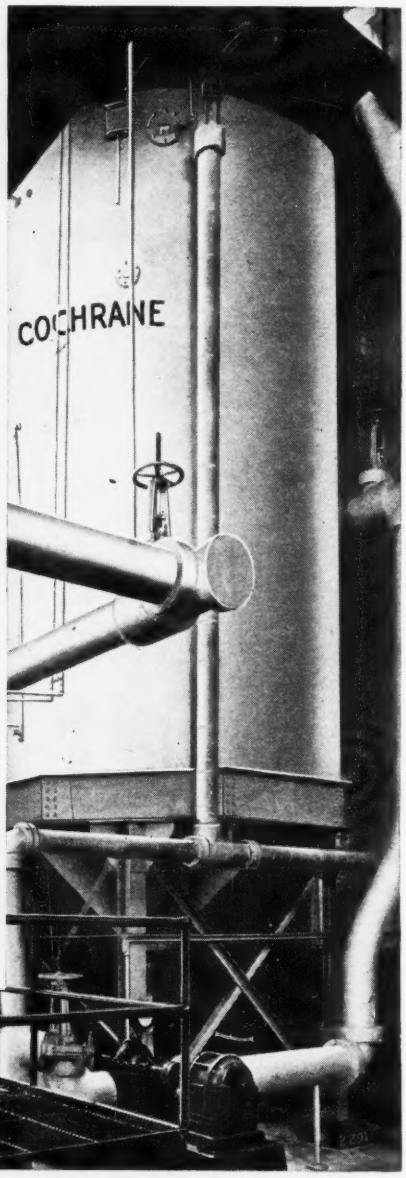
CORROSION: by removing oxygen from the water and establishing a proper pH value, or degree of alkalinity of boiler water.

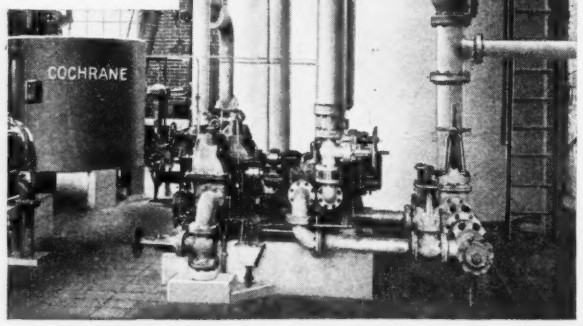
EMBRITTLEMENT: by maintaining a proper ratio of sodium sulphate to sodium carbonate, depending upon boiler pressure, as recommended by the A.S.M.E. Boiler Code Committee.

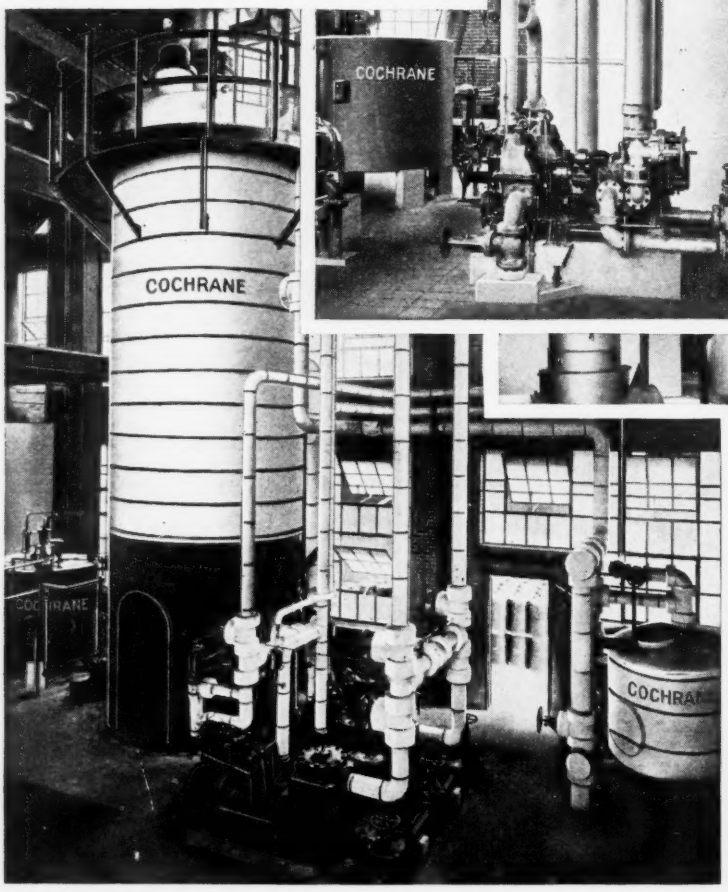
The Hot Process Softener and the Deaerating Heater, by which these results are achieved, are pioneer developments of the Cochrane Corporation. The benefit of this long and varied experience is available to you in the solution of your scale and corrosion problems.

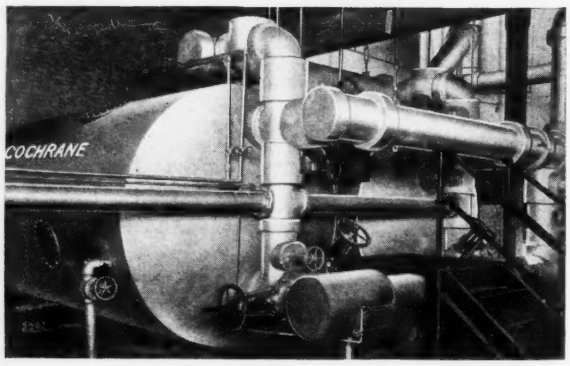
COCHRANE CORPORATION
Dept. A-13 17th & Allegheny Ave.
PHILADELPHIA, PA.









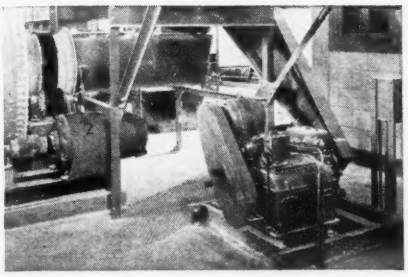


COCHRANE

WATER SOFTENERS • DEAERATING HEATERS • FILTERS • BLOW-DOWN EQUIPMENT • VALVES • FLOW METERS

What's New

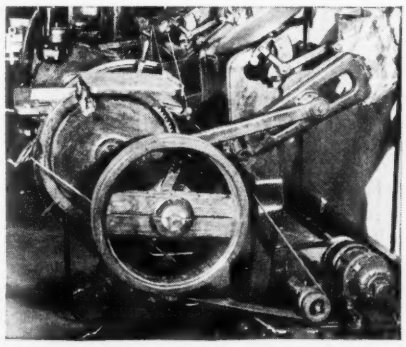
IN VARIABLE SPEED APPLICATIONS



Varies Rate of Feed

IN THE new sewage plant at Perth Amboy, N. J., a REEVES Variable Speed Transmission regulates the feed of chemicals to coagulate the sewage.

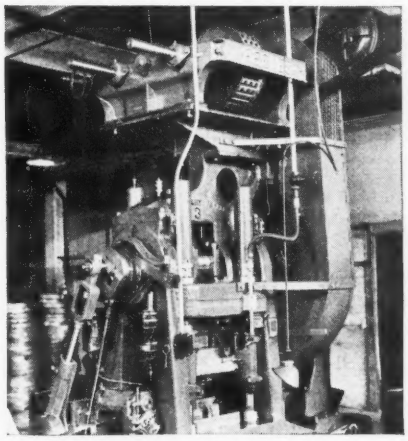
The variable speed shaft of the Transmission is connected through a speed reducer to a conveyor-feeder. This conveyor feeds lime, ferric chloride and paper pulp to the sewage. Through REEVES Electric Automatic Control on the Transmission, the rate of feed is automatically varied in exact proportion to rate of sewage flow. A REEVES Transmission is also used in this plant to control a sludge filter.



Steps Up Production

REEVES engineers have developed an exceedingly efficient, low-cost variable speed drive for platen printing presses.

This drive is an application of the REEVES Vari-Speed Motor Pulley—the simplified speed control unit which is applied directly to standard shaft extension of any constant speed motor. With extended handwheel control as pictured above, the operator can conveniently and instantly change speed of press to secure exactly the rate of impressions needed to match the job being run. The REEVES Vari-Speed Motor Pulley provides infinite speed variation over 3:1 range, and is available in seven sizes for requirements ranging from fractional to 7½ H. P.



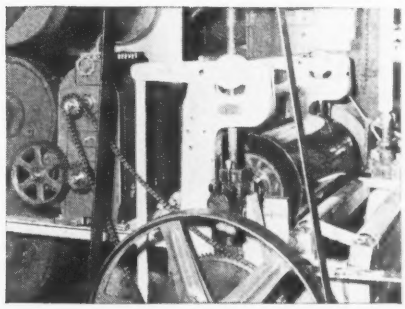
Widens Work Range

THE WORK range of this punch press is greatly increased by the application of a REEVES Variable Speed Transmission. Now, by turning a handwheel control, the speed of the press is changed to compensate accurately for different sizes and shapes of parts to be blanked, different widths or thickness of metal stock, type and temper of material. Further efficiency is secured by feeding coiled stock from a Roll Feeding Straightener also regulated by a REEVES Transmission.

Peripheral Speeds

A LARGE southern bleachery desired to synchronize the peripheral speeds of a water mangle operated in series.

This machine has two rolls one above the other between which cloth is passed to pre-wet it and mash the yarn flat. The top roll is frictionally driven and often an excessive drag results which twists and turns the yarn. REEVES engineers worked out an application of the REEVES Transmission—space-saving vertical design. Now by turning a handwheel, absolutely uniform peripheral speeds are maintained—or top roll may be made to lag by exactly the proper amount for any kind of finish desired.



For Your Machines

REEVES engineers have developed a complete line of variable speed equipment to insure a correct installation for every requirement. Sizes: fractional to 100 H. P.; speed ratios 2:1 to 16:1, inclusive.

Modern, compact, widely adaptable open and enclosed designs in vertical and horizontal types. Many controls—manual, electric remote and completely automatic.

Look to REEVES for accuracy in variable speed control and for dependability. No other speed control unit can equal or closely approach the record of REEVES Transmissions on these fundamental points. A nation-wide engineering service—available without obligation.

More than 80 different applications of REEVES *Speed Control are illustrated and described in the new* REEVES *Speed Control Handbook.*

REEVES PULLEY CO., COLUMBUS, INDIANA

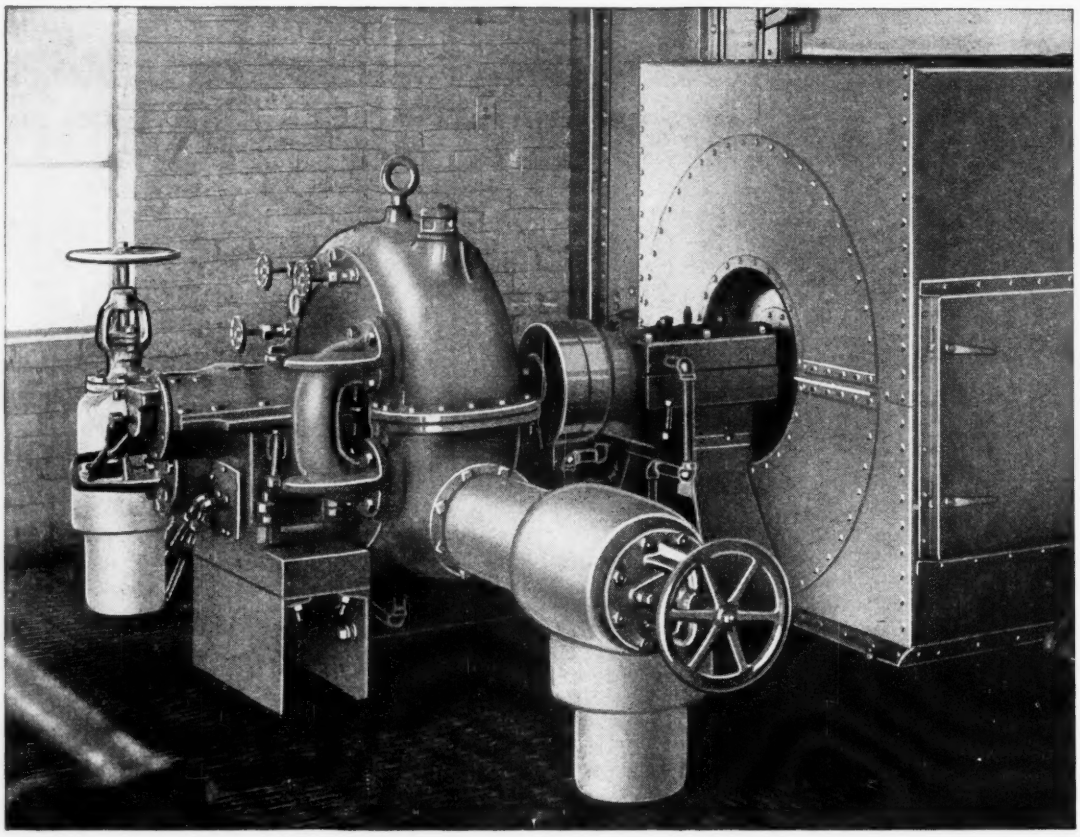
Send information on latest, most efficient methods of Speed Control as contained in your new Handbook P-35. (12-35)

Name .....

Company .....

Address .....

TERRY



FOR SMALL MODERATE SPEED DRIVES, USE THE EFFICIENT SOLID WHEEL TERRY TURBINE

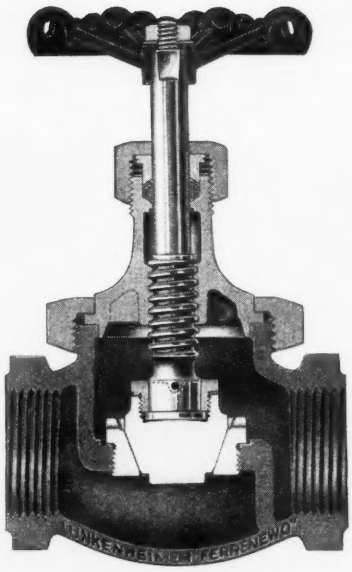
The Terry Wheel Turbine, in addition to its advantages of ruggedness and reliability, also has the important feature of high efficiency at low speeds.

It is therefore possible to employ the Terry Turbine direct connected to relatively slow speed equipment such as fans, pulverizers, etc., and obtain a good overall efficiency.

A typical application is shown above. This consists of a 75 h.p. steel casing solid wheel Terry Turbine direct connected to an induced draft fan. The unit operates at 1750 r.p.m. and makes a compact and efficient outfit.

T-1107

The TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.
Steam Turbines - Gears

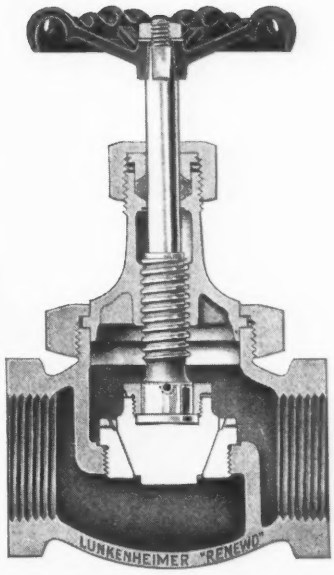


Iron Body "Ferrenewo"
Fig. 1021-P, 150 lb. SP.

NS5
SEATS AND DISCS
PATENTED

LUNKENHEIMER

PLUG TYPE



Bronze "Renewo"
Fig. 73-P, 200 lb. SP.
Fig. 16-P, 300 lb. SP.

"FERRENEWO" and "RENEWO" VALVES

for Throttling, Drain, Drip, Water Column Blow Down and other Severe Service—also preferred by some users for General Service

• "NS5" Alloy (patented in U. S.) the material of which Plug Type Seats and Discs are made is a new and exclusive development—the result of exhaustive research in the Lunkenheimer laboratories. It is a non-ferrous composition of uniformly great hardness (300 Brinell) and retains its hardness at high temperatures. "NS5" will not gall; it is resistant to wear, abrasion, erosion and corrosion.

• The plug type disc is deep-seated and ground into its own seat, to a uniform bearing from end to end. Each plug is properly tapered with long bearing contact to fit snugly into its seat—just like a cork in a bottle—providing a fit as perfect as can be made to insure a tight seat and satisfactory service.

• Most valve users have troublesome throttling, drain, drip, water column blow down and other severe service which play havoc with seats and discs. With the combination of correct design and "NS5" seating material, Plug Type Valves approximate as closely as possible a satisfactory solution to these problems.

The interchangeability of parts between Plug Type and Full-Way "Renewo" and "Ferrenewo" Valves is explained in the new booklet F 541. May we send you a copy?

Available through the local Lunkenheimer distributor.

THE LUNKENHEIMER CO.
"QUALITY"
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NEW YORK CHICAGO BOSTON
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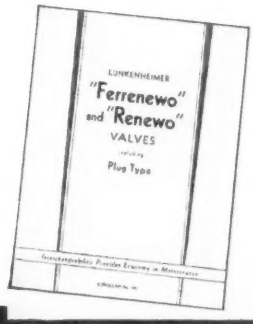
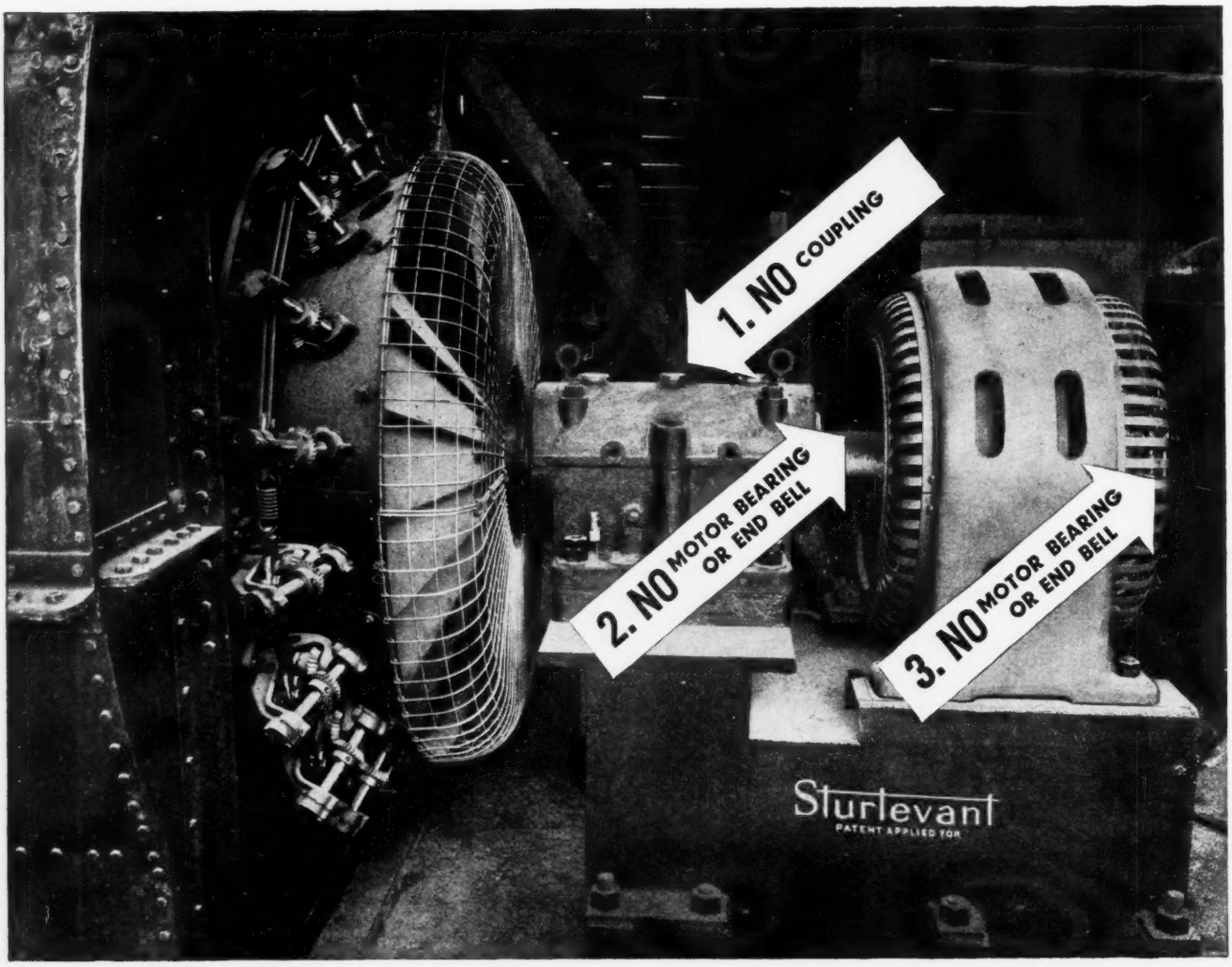


BOILER MOUNTINGS — LUNKENHEIMER VALVES — LUBRICATING DEVICES

102-71PA-42

GONE!

1. THE COUPLING
2. MOTOR BEARINGS
3. AND END BELLS



SEE how the synchronous motor rotor is *overhung* on the shaft of the above Sturtevant Vane Control Mechanical Draft Fan. Result: coupling, motor bearings and motor end bells... ALL ELIMINATED!

Advantages: (1) possibility of motor bearing trouble eliminated; (2) coupling wear banished; (3) no misalignment by vibration; (4) saving in equipment cost; (5) elimination of the commonly used and more costly variable speed motor and its complicated control.

Sturtevant makes available mechanical draft equipment at its highest stage of development, in simplicity, efficiency and dependability. This is a typical example.

We would welcome your inquiry regarding Sturtevant Fans, Steam Turbines, Reduction Gears, Air Heaters or Economizers.

B. F. STURTEVANT CO., Hyde Park, Boston, Mass.
Branch Offices in 33 Other Cities

B. F. STURTEVANT COMPANY of CANADA, Ltd., GALT.
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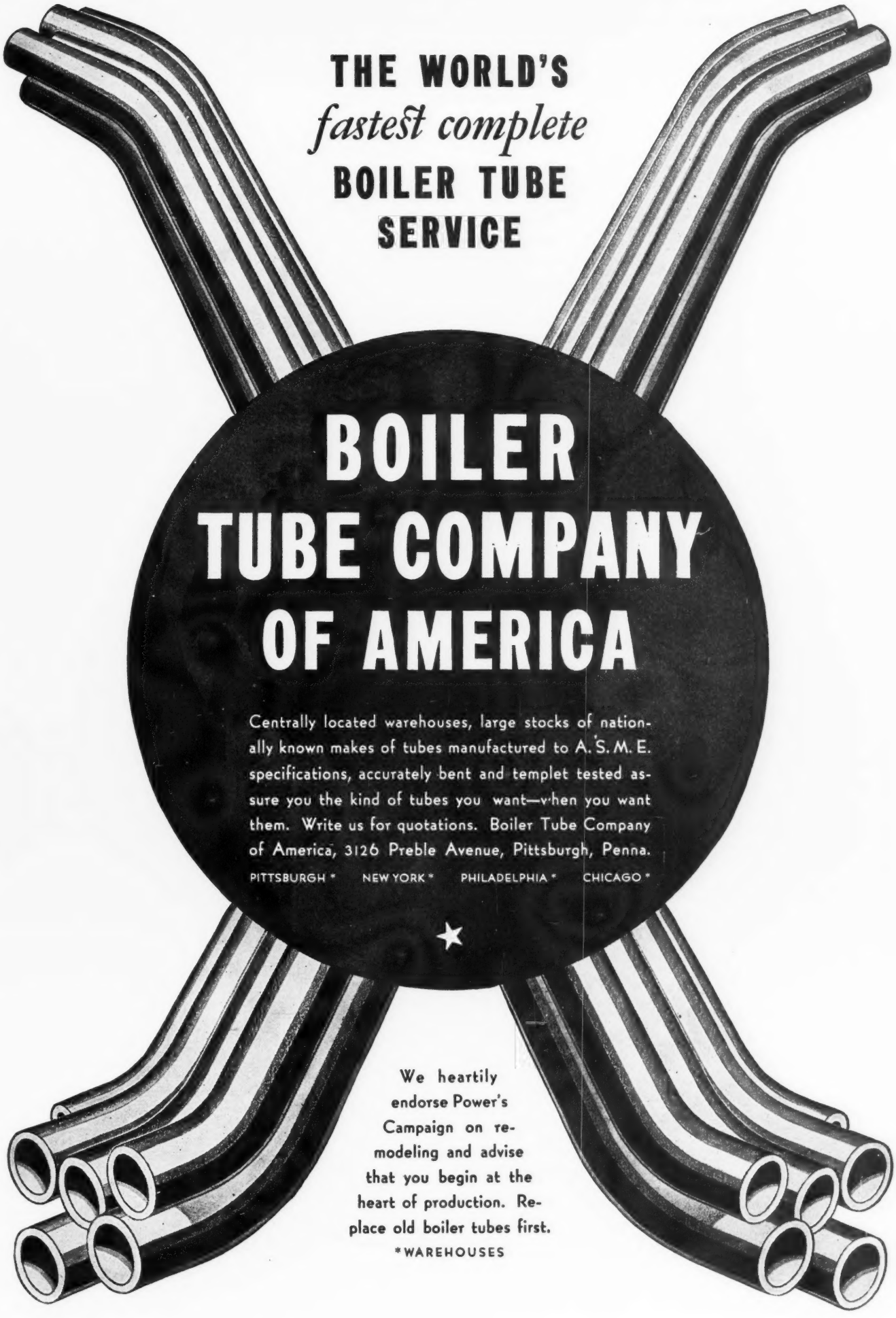
DRAFT FANS · TURBINES · GEARS · ECONOMIZERS · AIR HEATERS



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Centrally located warehouses, large stocks of nationally known makes of tubes manufactured to A. S. M. E. specifications, accurately bent and templet tested assure you the kind of tubes you want—when you want them. Write us for quotations. Boiler Tube Company of America, 3126 Preble Avenue, Pittsburgh, Penna.

PITTSBURGH * NEW YORK * PHILADELPHIA * CHICAGO *

We heartily endorse Power's Campaign on remodeling and advise that you begin at the heart of production. Replace old boiler tubes first.

*WAREHOUSES

"THANKS OLD MAN- You're The Best Year We've Ever Had"

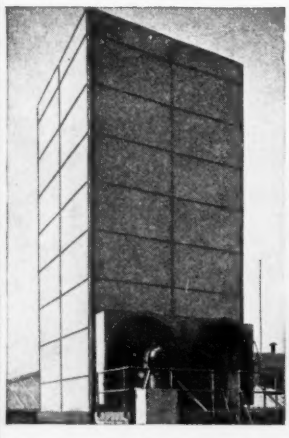
WE sincerely appreciate the greatly increased volume of business that has made 1935 the best year in the history of our organization. We have endeavored to merit that patronage by designing water cooling systems with specific, demonstrable advantages that would provide maximum protection for any water cooling investment.

★ ★ ★ ★ ★ ★

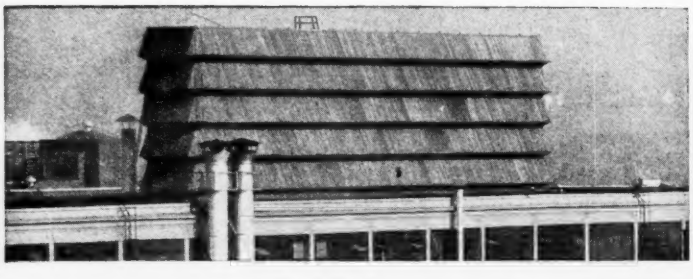
NINETEEN-THIRTY-SIX will bring forth a completely re-designed Marley line — with improvements, refinements, new standardized units and sizes, new PROVED performance records. Look for announcements soon; write Marley for anything in the water cooling line.

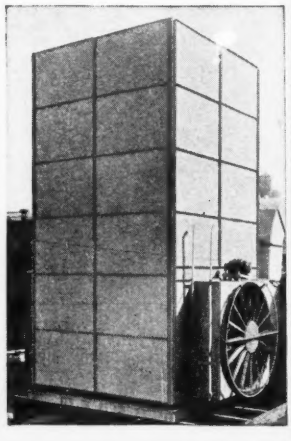
THE MARLEY COMPANY

1915 Walnut **Kansas City, Mo.**



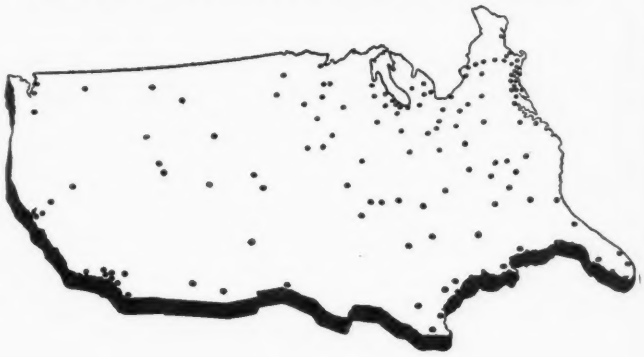
Let Us Spray
COOLING MARLEY EQUIPMENT
"THE BETTER WAY"





"Just Around the Corner"

AMERICA'S INDUSTRIES FIND CRANE STOCKS



• Crane service in valves, fittings, and piping is a *localized* service. Within 24 hours of every factory in the United States, and within one to two hours of a great majority of them, complete stocks of Crane valves and fittings are available.

The Crane line is extensive, capable of answering the daily requirements of the 209,348 industrial establishments within the service areas where Crane stocks are carried.

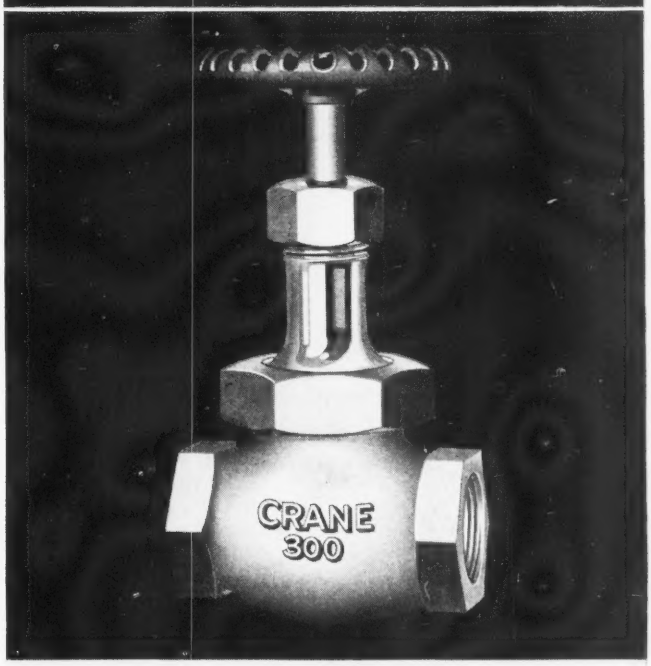
Crane materials will help you solve any piping problem. If extensive modernization is contemplated, the Crane Finance Plan allows you to spread the cost over a period of years.

CRANE SHOP FABRICATION SERVICE

Design — Flanging
Casting — Cutting
Bending — Threading
Welding — Assembling

There is a Crane Valve or Fitting for every piping requirement

PLUG-TYPE DISC



Crane 382-P Brass Globe Valve

1 Built for severe service on steam pressures to 300 pounds — temperatures to 550° F.

2 Scientifically designed plug type disc is ideal for throttling service.

3 Width and angle of seating surface gives long service life but does not restrict flow or permit disc to wedge in seat.

4 Stem thread parts made of metals selected for their wear resisting qualities.

5 Seats and discs are regrindable.

CRANE

CRANE CO., GENERAL OFFICES: 836 S. MICHIGAN AVE., CHICAGO, ILLINOIS • NEW YORK: 23 W. 44TH ST.

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CRANE VALVES, FITTINGS AND PIPE FABRICATION

MODERNIZE STEAM TRAPS

Why?

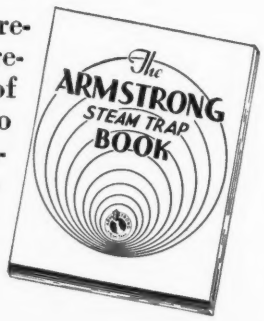
IN a list of 24 reasons for modernizing industrial equipment, published recently by a leading industrial magazine, the following 14 apply directly to the replacement of old traps with Armstrongs.

1. Obsolesence (Difficulty of obtaining repairs.)
2. High Maintenance Cost (Of obsolete or poorly constructed traps.)
3. Invention (Of free floating lever trap.)
4. Excessive Supervision (On part of M. M. or pipe fitter.)
5. Increasing Production Volume (From hotter machines.)
6. Reducing Floor Space (Increased production from hotter machines.)
7. Heavier Duty Production (With hotter machines.)
8. Higher Speed Production (With hotter machines.)
9. Economy of Fuel and Power (Steam savings.)
10. Eliminate Manual Operations (Of bypasses, air cocks, drains.)
11. To Decrease Noise in Operation (Eliminate water hammer.)
12. To Create Greater Safety (For engines, heater tubes, etc.)
13. To Stabilize the Rate of Production (Uniform machine temperature.)
14. To Create Incentives to Efficiency (Coal savings, lowered maintenance costs.)

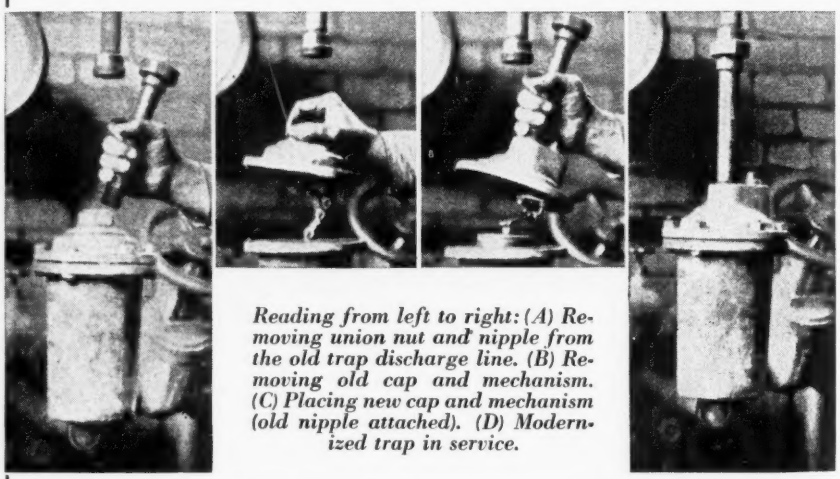
How?

1. If you have no traps or old ones of another make . . .

It is easy to get traps best suited to your requirements. The nearest Armstrong representative will gladly give you the benefit of his many years' specialized experience to get exactly the right trap out of the complete Armstrong line. For your own information, get a copy of the Armstrong trap book. It is a complete catalog and more. It contains valuable information on trap practice and application.



2. If you have old Armstrong Traps



Reading from left to right: (A) Removing union nut and nipple from the old trap discharge line. (B) Removing old cap and mechanism. (C) Placing new cap and mechanism (old nipple attached). (D) Modernized trap in service.

The design of the present Armstrong trap, with the latest improvements, permits the use of old Armstrong trap bodies and existing pipe connections. The increased capacity for handling either condensate or air can be easily secured at low cost by the simple operation pictured above. Complete information and prices on this modernization are available from Armstrong representatives or in the Armstrong trap book.

ARMSTRONG
MACHINE WORKS. *Three Rivers, Mich.*

Powell valves are universally accepted for

Design
Materials
Workmanship

AND STEAM SERVICE!

FOR OIL, GAS, WATER, AIR,

Performance
Long-Life and
Precision

A complete line of valves .... up-to-the-minute in design .... of quality materials and workmanship! That's why engineers are selecting Powell Valves for long, trouble-free performance.

THE WM. POWELL CO.
2525 SPRING GROVE AVENUE
CINCINNATI, OHIO

POWELL VALVES

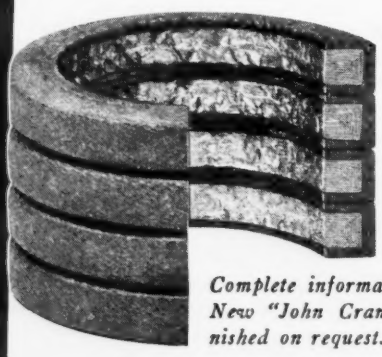
"John Crane" METALLIC NEW Packing

STYLE 300 "Edge-On"

This new packing—very flexible and resilient—has a metallic wearing face of anti-frictional babbitt foil, folded in a manner which provides an "Edge-On" contact with the rod and assures self-lubricating operation. The metallic insert is securely fastened to a heat resisting channel of asbestos which provides the proper resilience to maintain a most perfect seal.

The "Edge-On" metallic insert provides reservoirs of lubricating oil and graphite which flow freely to the face of the packing. Rods and shafts become highly polished—reducing friction to a minimum. Records of six and eight years continuous service from "John Crane" Metallic Packing installations are not uncommon.

Recommended Uses—This packing is self-lubricating—very anti-frictional and is entirely suitable on air, steam, ammonia, gas and water services.

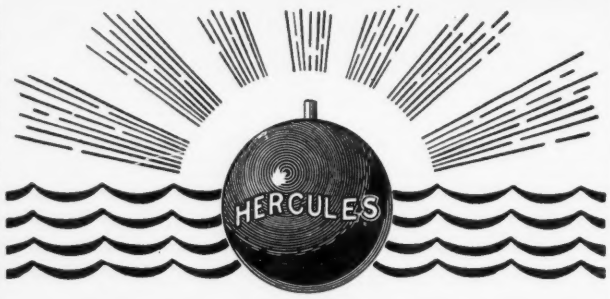


Manufactured in 12 foot spirals—easily cut into rings or sets.

Moulded rings of die-formed sets can be supplied when specified. A form that always saves time on installations.

Complete information on this and other New "John Crane" Styles will be furnished on request.

CRANE PACKING COMPANY
1801 Cuyler Avenue, Chicago, Illinois
Branch Offices in Principal Cities.



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Not when HERCULES Seamless Copper Floats are used to maintain the water level in heaters, tanks, reservoirs and other appliances.

The special spinning process assures uniform thickness of metal and high mechanical strength. Every Hercules Float is guaranteed to stand up under 350 lb. working pressure and 500 deg. temperature.

Ready to ship—all standard ball shaped sizes to 10 in. inclusive. Special shapes or sizes furnished promptly on order.

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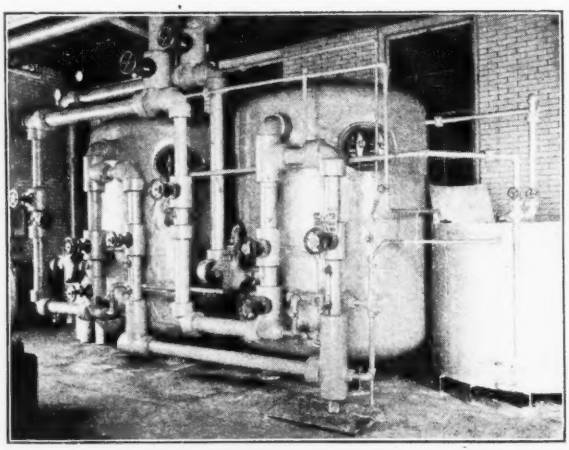
200 Franklin St., Springfield, Mass.

Water Softeners & Filters for every Industrial & Domestic Use



Scaife Zeolite Water Softener

Cold Process-Intermittent, Continuous and Zeolite, Hot Process, Semi-Hot Process and specially designed Water Softeners. Gravity, Pressure and Oil Removal Filters.

Write for Information and Bulletins.

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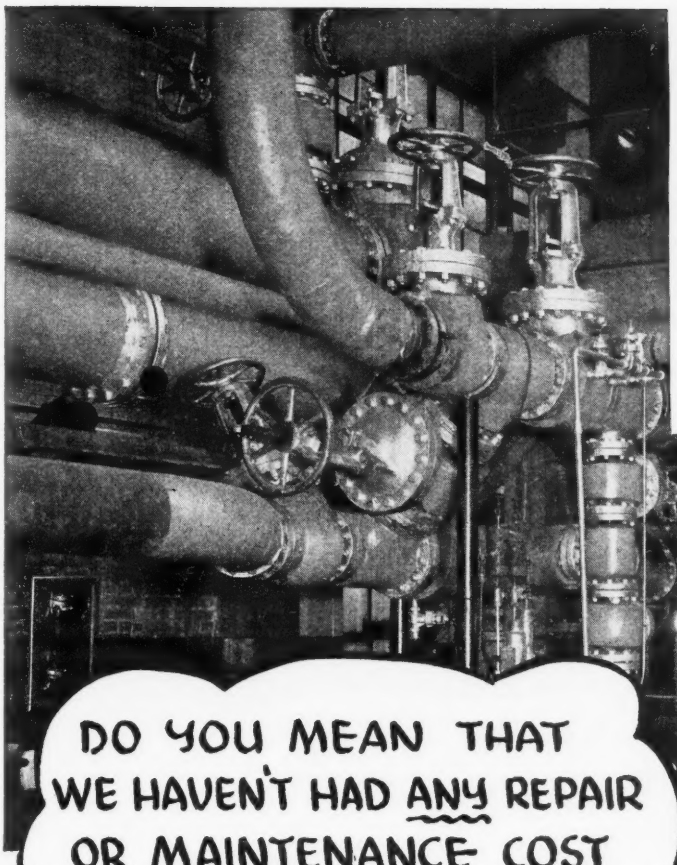
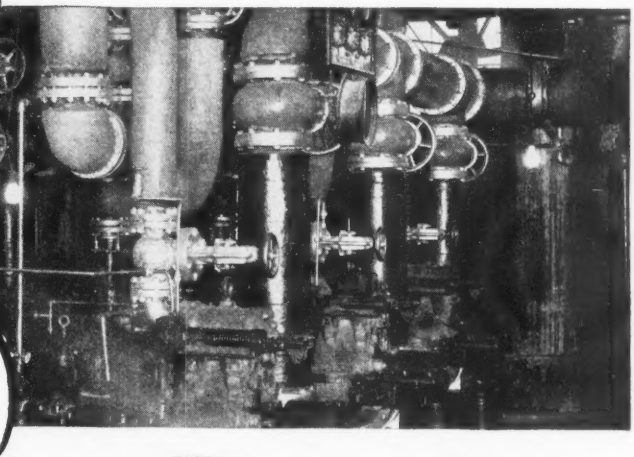


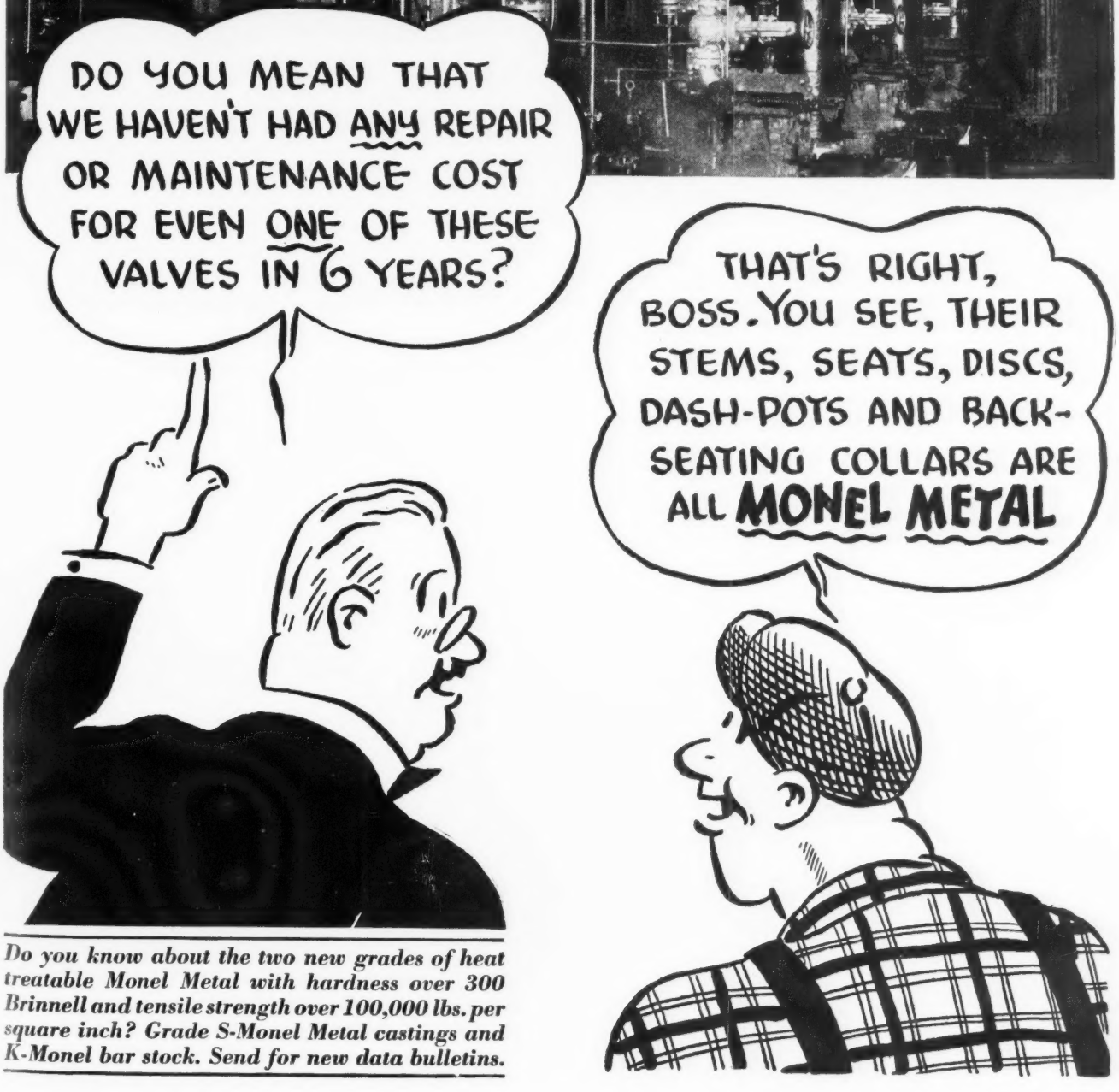


● Here you see Monel Metal-trimmed cast steel globe, gate and non-return valves installed in 1928 in the boiler house of Davison Coke & Iron Co., Pittsburgh. These valves, all manufactured by Pittsburgh Valve Foundry & Construction Co., are completely trimmed with Monel Metal stems, seats, discs, dash-pots, and back-seating collars for 250 lbs. W.S.P. at 507°F.

During 6 years of continuous service to 1935, not one of these valves has required any maintenance or repair expense, nor have any parts been replaced. Recent inspection indicates that the Monel Metal trim is still in perfect condition for indefinitely further service.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.

Monel Metal is a registered trade-mark applied to an alloy containing approximately two-thirds Nickel and one-third copper. Monel Metal is mined, smelted, refined, rolled and marketed solely by International Nickel.


DO YOU MEAN THAT WE HAVEN'T HAD ANY REPAIR OR MAINTENANCE COST FOR EVEN ONE OF THESE VALVES IN 6 YEARS?
THAT'S RIGHT, BOSS. YOU SEE, THEIR STEMS, SEATS, DISCS, DASH-POTS AND BACK-SEATING COLLARS ARE ALL MONEL METAL

Do you know about the two new grades of heat treatable Monel Metal with hardness over 300 Brinnell and tensile strength over 100,000 lbs. per square inch? Grade S-Monel Metal castings and K-Monel bar stock. Send for new data bulletins.

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Air, steam or water driven

★ Airetools are made to meet every condition of tube or pipe incrustation encountered in power plant operation. Powerful motors equipped with latest type of self-feeding cutter heads and for return tubular boilers efficient vibrator heads. Sizes from 5/8" to 20" diameter — all made from best materials, properly machined, heat treated and ground to slip fit. Clean thoroughly, swiftly and without the slightest danger of tube injury.

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So confident of Airetools are we that we are making this extraordinary offer: *Rip out the coupon below, checking your requirements, and we will send you, express prepaid, an Airetool Cleaner to suit your needs. Test it for 30 days and if you find that it does not do a better, quicker and more thorough job, return it at our expense and that ends the matter!*

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SPRINGFIELD, OHIO

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Ship us express prepaid,
☐ Cleaner complete.
☐ Cutter head only suitable for use checked below. We will test it for 30 days at no cost. If, at the end of the test period, it hasn't proved itself a faster and more thorough cleaner we will return it at your expense.

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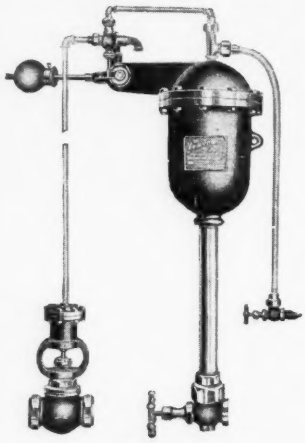
Check your Requirements: ☐ O-D Tubes ☐ Straight Tubes ☐ Curved Tubes ☐ Water Tube Boiler ☐ Return Tubular Boiler.

Cuts Down Fuel Cost Improves Efficiency Eliminates a Hazard



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VIGILANT
Feed-Water
REGULATOR

Automatic, simple, accessible, unfailing, the "Vigilant" Feed-Water Regulator gets better steam production from the boiler to which it is attached, by holding the water level more perfectly constant than human attention can possibly do. The steadying of operation thus effected results in lower fuel cost. And the serious hazard that attends uncertain ups and downs of water level is definitely removed. Ask for Bulletin 2514, also catalog of Chaplin-Fulton Regulators for all needs of pressure control.

THE CHAPLIN-FULTON MFG. CO.
28-40 Penn Avenue **Pittsburgh, Pa.**

With DEMING Water Lubricated Turbine Pumps

● Dependable, low cost water supply! That's the short, short story about Deming Deep Well Water Lubricated Turbine Pumps.

Eliminate all possibility of oil contamination. Water lubrication assures that.

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The pacemaker in
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THE most exacting basis for judging wire rope performance is AVERAGE SERVICE.
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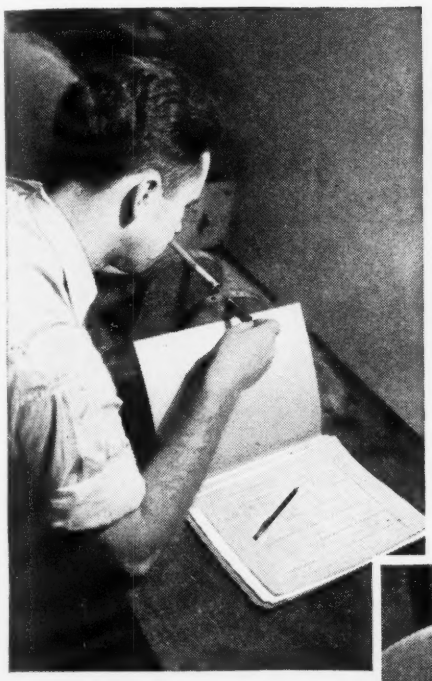
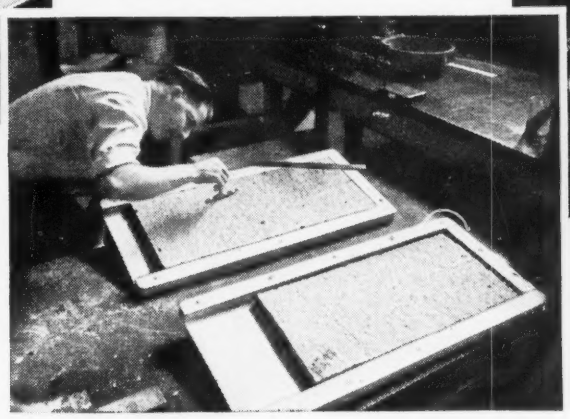
Guardians of the B.t.u.



Johns-Manville
INDUSTRIAL INSULATIONS
For every temperature condition from 400° F. below zero to 3000° F. above.

(*Right*) Switchboard that controls the power supplied to the heaters in conductivity testing units at the J-M Insulation Laboratories. Power input to any heater may be measured to within ½ of 1 per cent.



(*Above*) A split hair at furnace heat! Measuring with a micrometer gauge the thermal changes of a high-temperature insulation material. Furnace at left containing test specimen is accurately controlled. Expansion or contraction at high temperatures must be fully understood before recommendations for specific installations are given.

(*Left*) Measuring and evaluating dried test specimens of insulating cements at the J-M Insulation Laboratories. The same weight of material was employed for both specimens. Note high shrinkage of the one in the foreground.

IN THESE photographs, in these brief captions, we can give you no more than a few hasty glimpses into our Thermal Insulation Laboratories, at Manville, N. J., largest in the world.

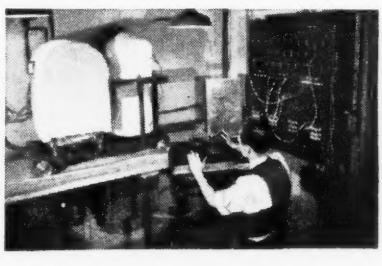
But we hope that you will come right into the laboratories with us, through the medium of our new brochure, entitled "Guardians of the B.t.u."

Here, in highly realistic photographs and interesting text, there is unfolded the fascinating story of many men who are devoting their lives to the study of one subject... the *control of heat*.

Their equipment, their experiments, their tests, cannot fail to be of interest to any technical man.

And, if your interest in the subject is a more practical one, if you are concerned with the more efficient, more economical operation of any type of heated or refrigerated equipment, you literally cannot afford to ignore the importance of heat-control research as it is carried on daily at Manville... research which has resulted in savings to industry totaling hundreds of millions of dollars annually.

For your copy of "Guardians of the B.t.u.," please fill in and mail the coupon. Johns-Manville, New York City.



(*Right*) A recent J-M Insulation Laboratory development, this "heat eye" permits measurements of surface brightness, emissivity of heat from surfaces, etc.

JOHNS-MANVILLE, 22 East 40th St., New York City

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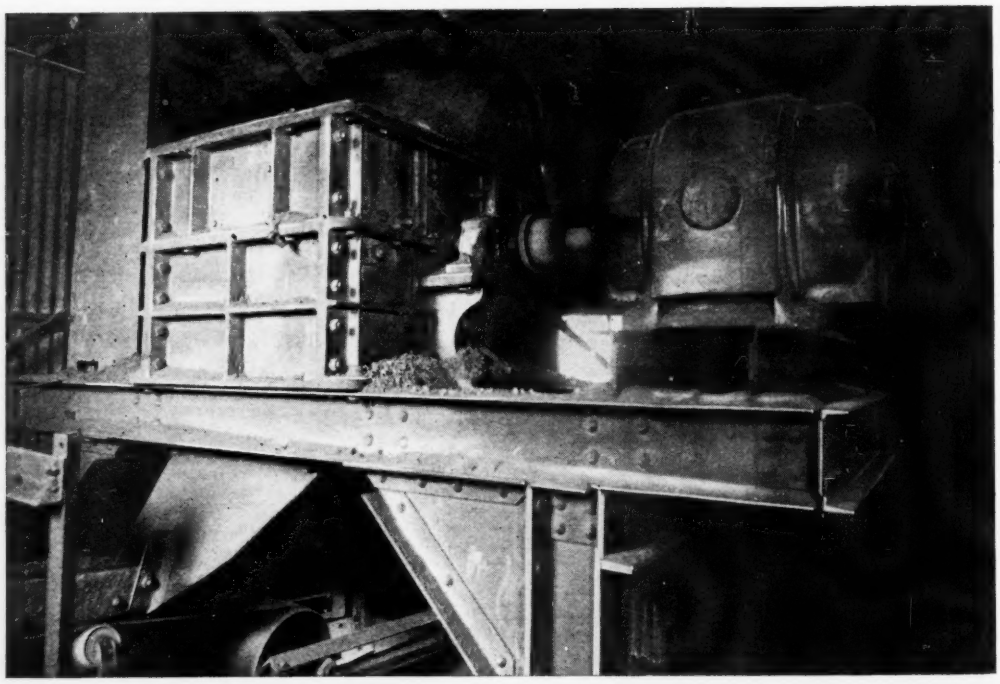
In the Heart of the Coal Country



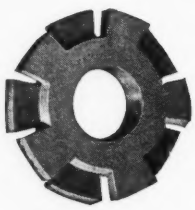
American Ring Crushers cut fuel costs and increase efficiency for WESTVACO

It was emphatically *no experiment* when the Westvaco Chlorine Products, Inc., So. Charleston, W. Va., installed two American Rolling Ring Crushers.

Many years of service in leading industrial and utility plants have PROVED that the perfect *coal sizing* made possible by this equipment has cut total costs from $2\frac{1}{2}$ to 8%, on either stoker use or pulverized coal burning—at almost unbelievably low crushing costs.

Thousands of tons of coal will pass through these crushers before replacement need even be considered. Higher plant operating efficiency is attained. Maintenance costs are negligible.

If YOU are not using American Ring Crushers you may be overlooking exactly what you need to cut YOUR full, operating and maintenance costs. Write today for complete information.



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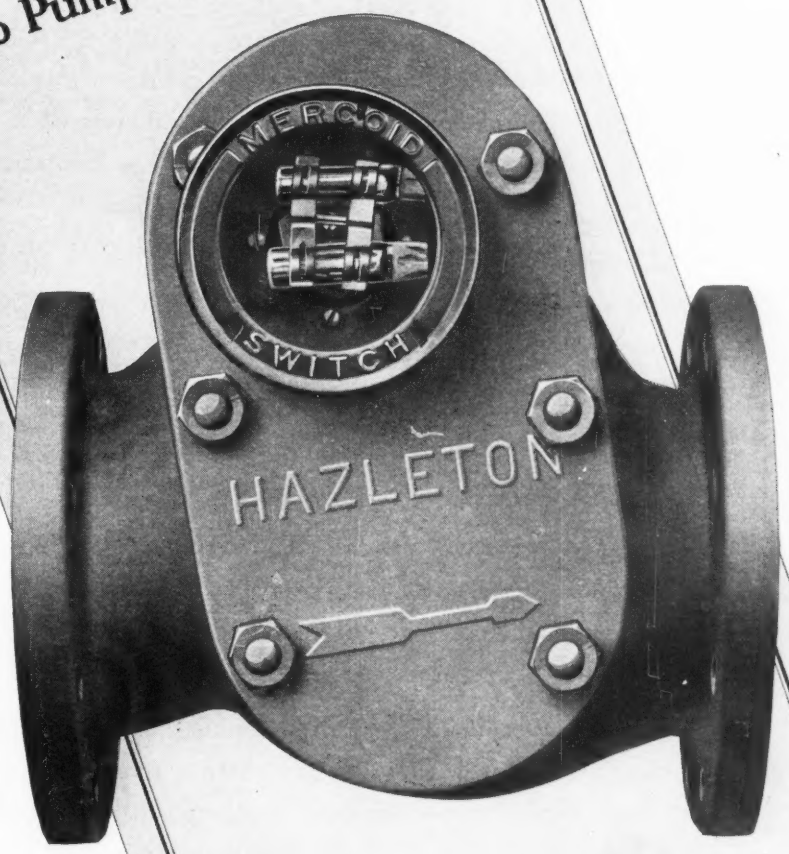

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. . . the tough, heat-resisting alloy for hottest zone soot blower elements

Bayer-Chronilloy is a specially developed chromium-nickel alloy for soot cleaner service which will withstand up to 2150° F. It possesses qualities which make it far superior to ordinary commercial chrome alloy seamless tubing commonly used for this service.

Strength and Ductility: Bayer-Chronilloy is not brittle, has great strength at elevated temperatures and because of its demonstrated heat resistance, toughness and rigidity to resist warping can absolutely be depended on for long life at low service cost.

Nozzles and Distal End are formed integral with the wall of the element—cannot loosen and blow out.

Resists Warping: The element wall is 15% thicker than walls of commonly used extra heavy wrought alloy tubing. Being throughout one homogeneous piece of material together with the heavy wall construction gives assurance against warping.

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Bayer engineers are at your service to help you realize the highest returns from your soot blower installation.

Write for detailed information concerning Chronilloy.

THE BAYER COMPANY
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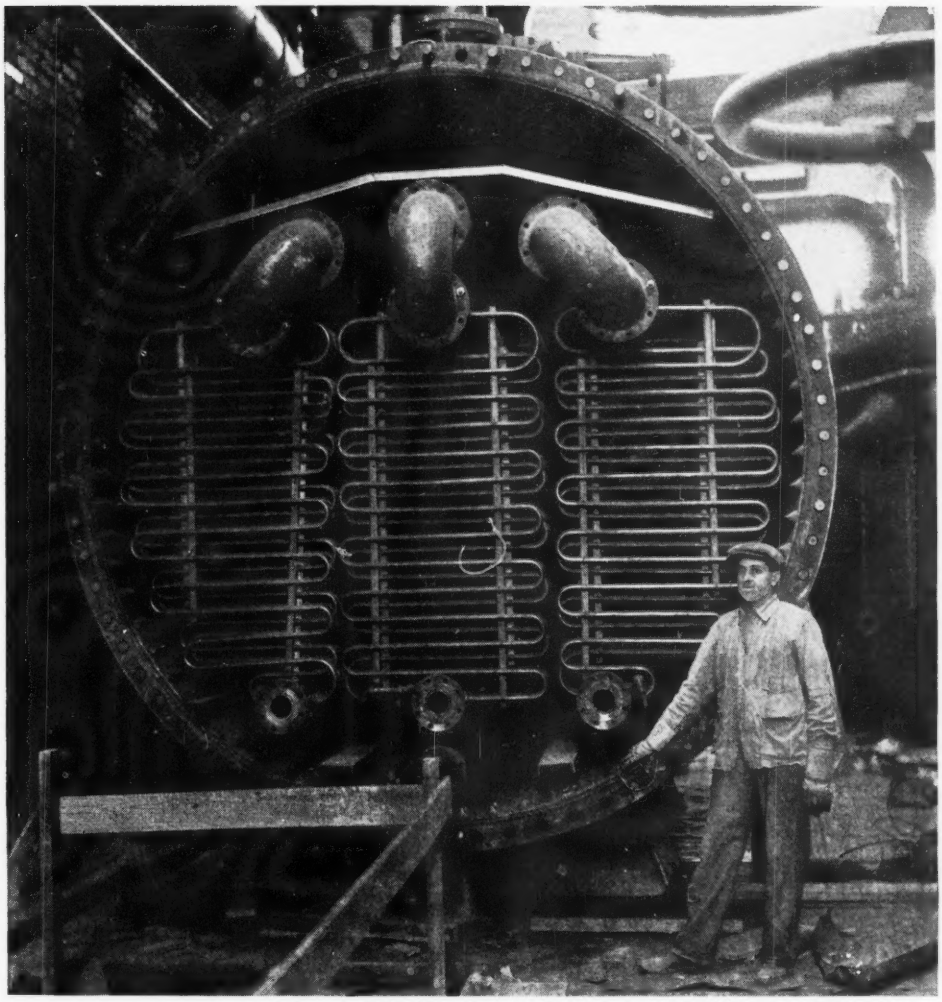

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High pressure boilers are much more sensitive to trouble from foreign matter in the water than low pressure boilers. Pure feed is, therefore, essential and is obtainable only through the use of evaporators. Many attempts at substitutions for pure water have been made, and when serious operating troubles occurred, the boilers have often been blamed.

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We invite correspondence with concerns properly equipped to manufacture and sell Fast's Friction Clutches, under license, to Power, Industrial, Marine and Automotive fields. It may be a single company, or several. We will also license European manufacturers in the above fields. Inquiries are solicited from responsible parties.

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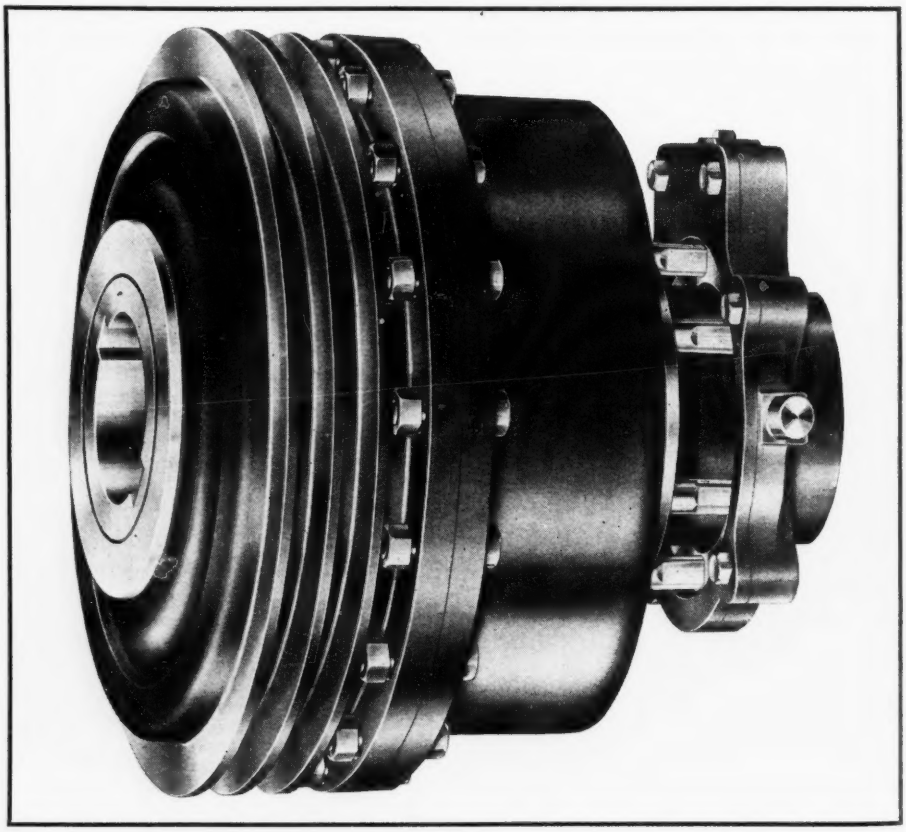

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permits the most economical layout for a particular expansion problem. Kellogg "Masterflex" bends and tangents can be produced to meet various flexibility requirements, space and operating conditions.

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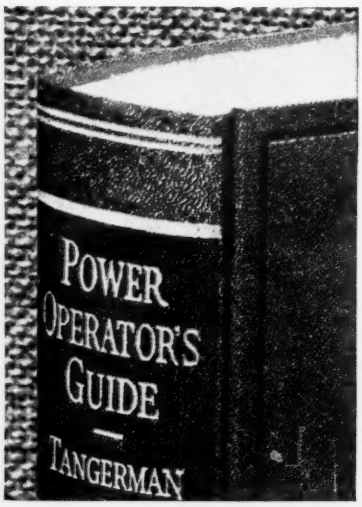

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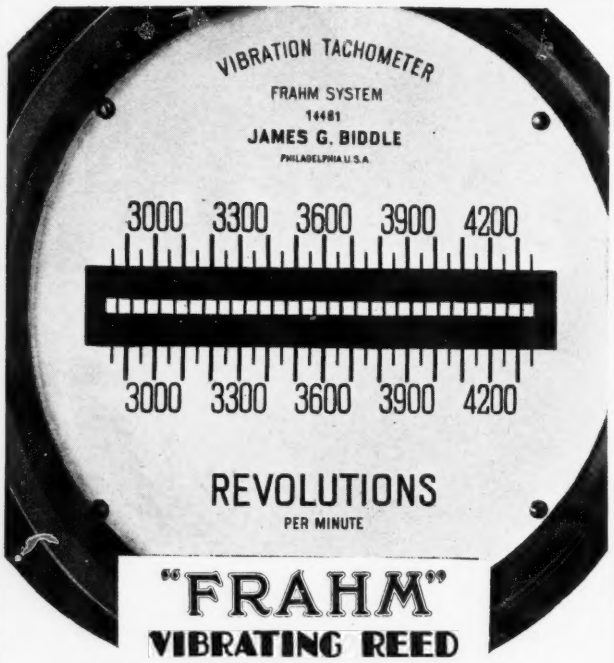

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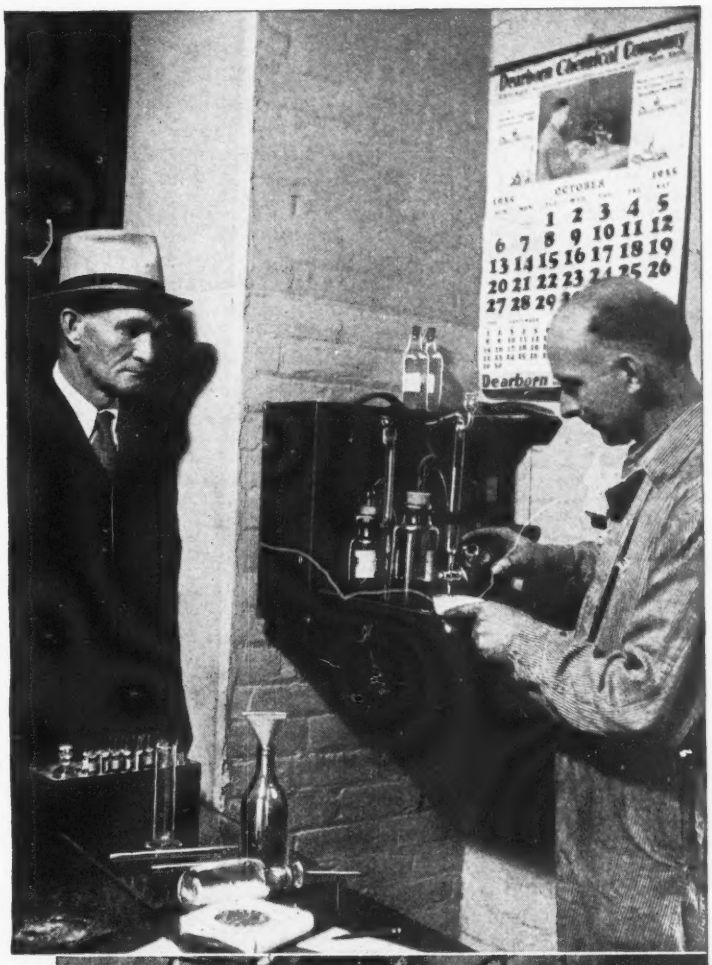

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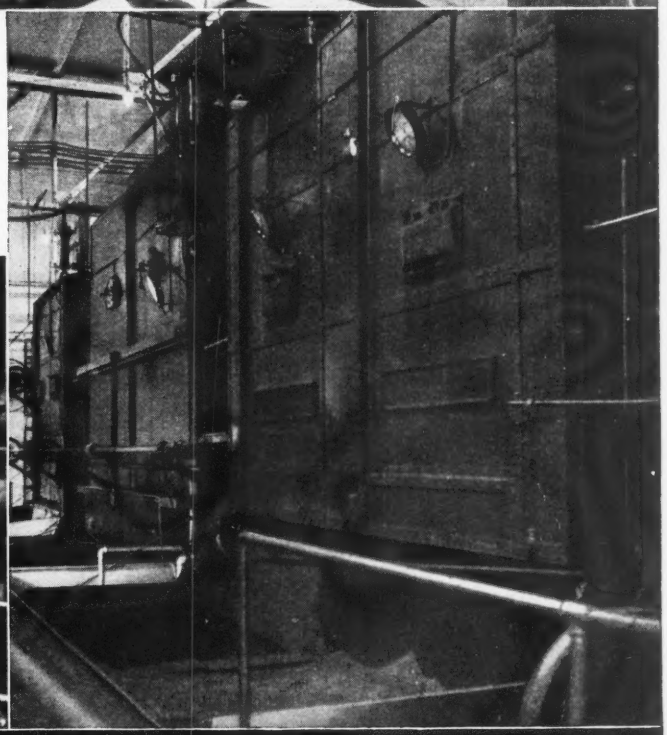

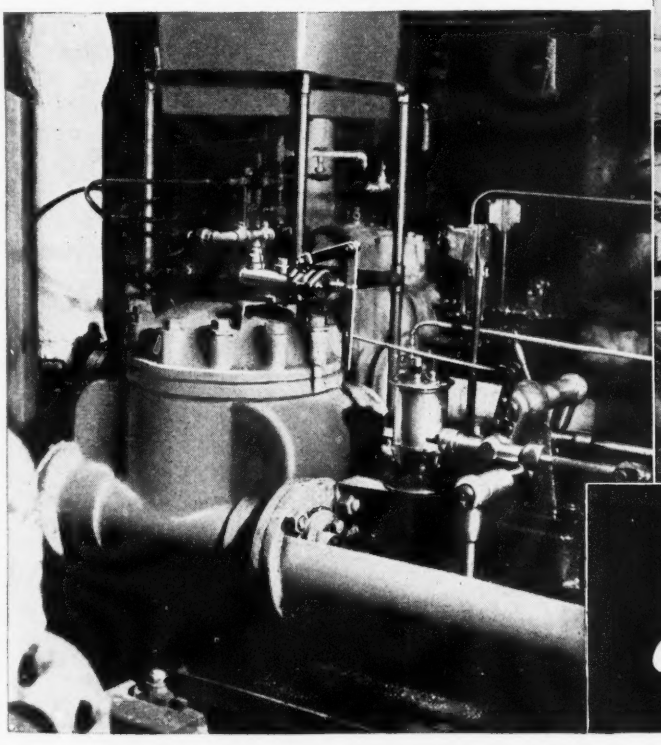

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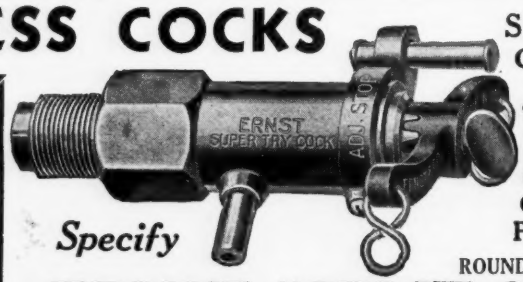

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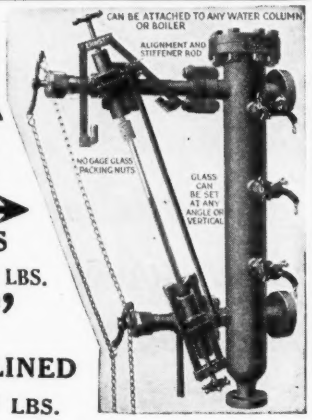
ROUND GLASSES FOR 1000 LBS.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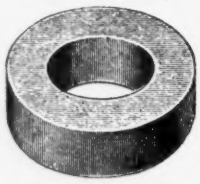

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We will be glad to quote on special constructions to meet individual requirements.

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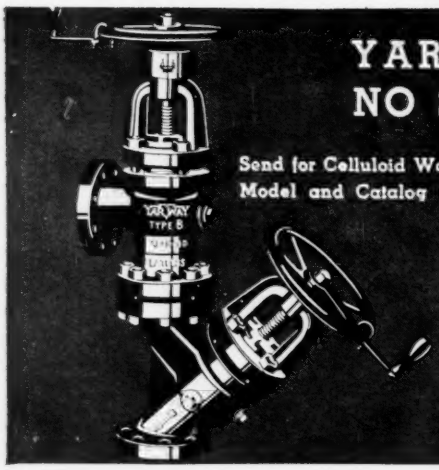

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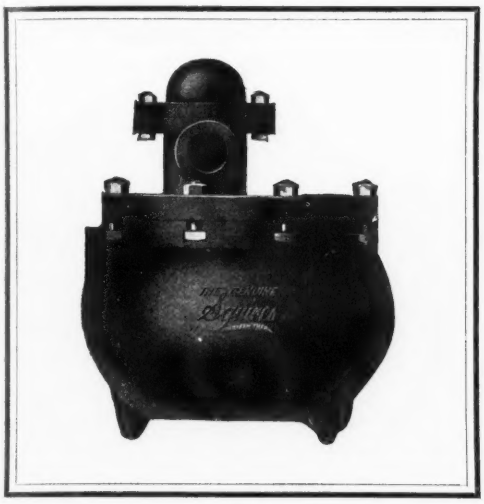

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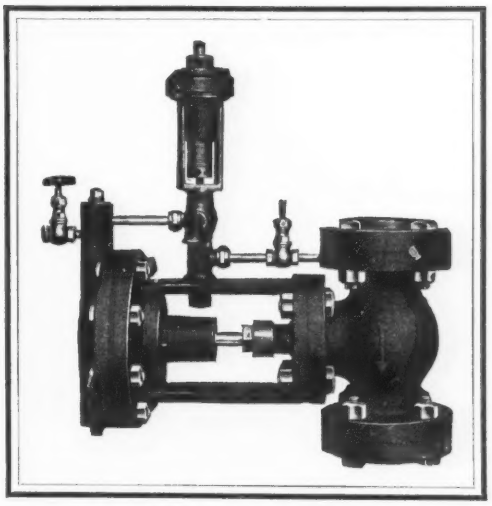

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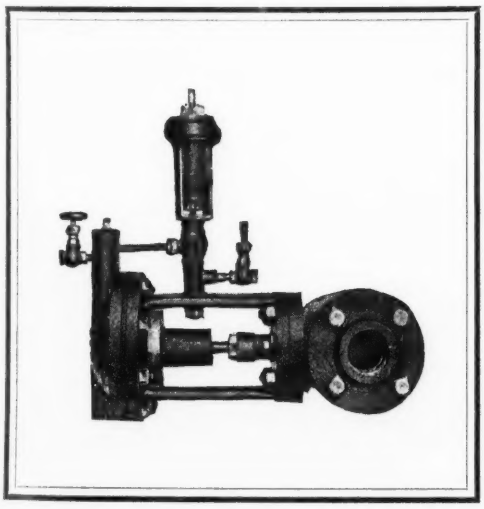

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Squires Feed Water Controllers will hold boiler water level at exact gauge. Feed follows demand closely, contributing much to good boiler operation. Simple—trouble free.

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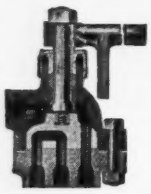

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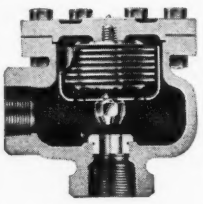

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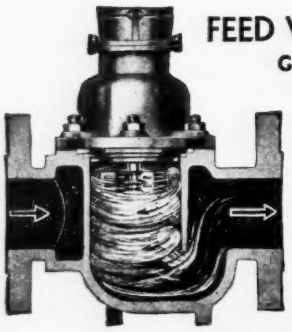

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They accurately measure the pulsating discharge of reciprocating pump.

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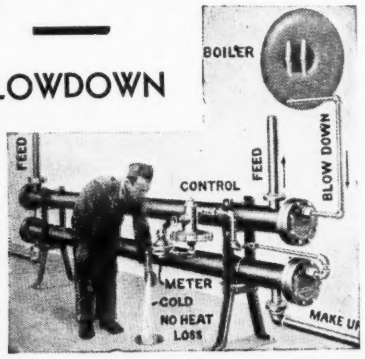

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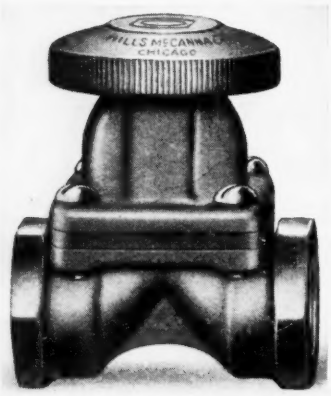

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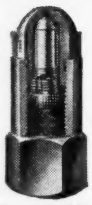

Fig. F-27

Use direct pressure only. Fig. F-27, illustrated, supplied in capacities from 1.08 to 30.0 G.P.H. @ 100 lbs. No. 2 furnace oil. Larger industrial oil nozzles up to 150 gal.

Bulletin No. 20

FOR AIR WASHING

For industrial air washers we recommend either ¼" Fig. 631 (female) or ⅜" Fig. 629 (male pipe-illustrated) Brass nozzles. Size delivering 68 G.P.H. @ 20 lbs. is recommended.

Catalog 6-C

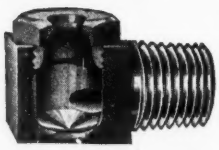

Fig. 629

FOR AIR CONDITIONING

¼"
Fig. H-261

For this work either the Monarch ¼" Fig. H-261 male or Fig. 642 female pipe thread Brass nozzles are used. These nozzles break the water up into the finest spray possible using direct pressure. Capacities from .57 to 18.17 G.P.H. @ 40 lbs. The 2.20 gal. size at 25 lbs. is mostly used.

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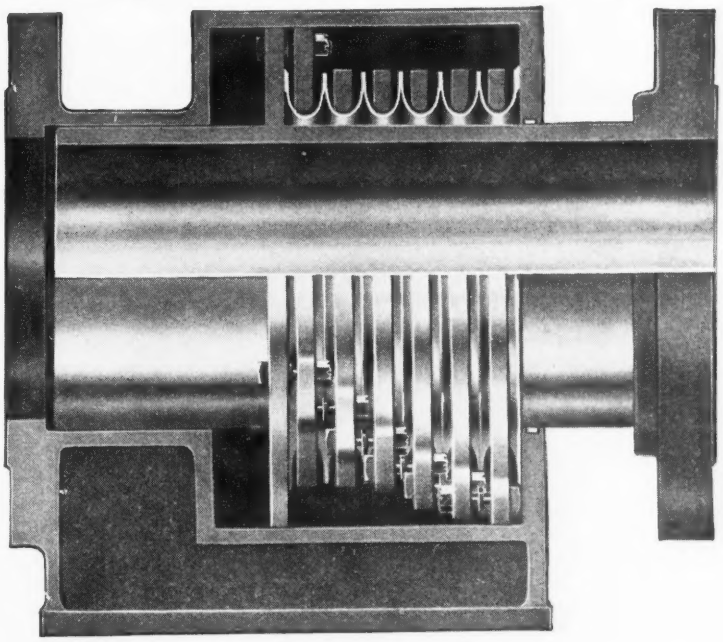

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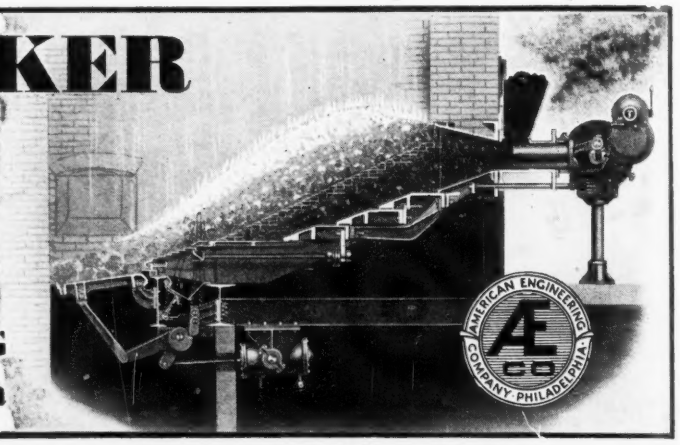

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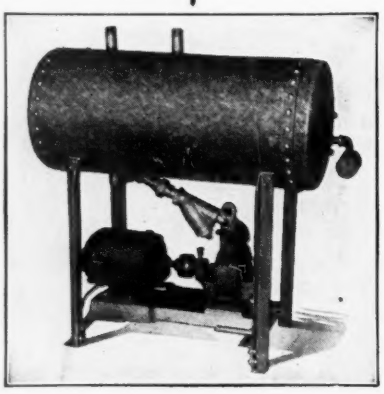

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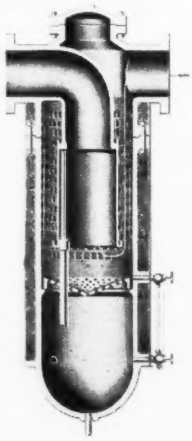

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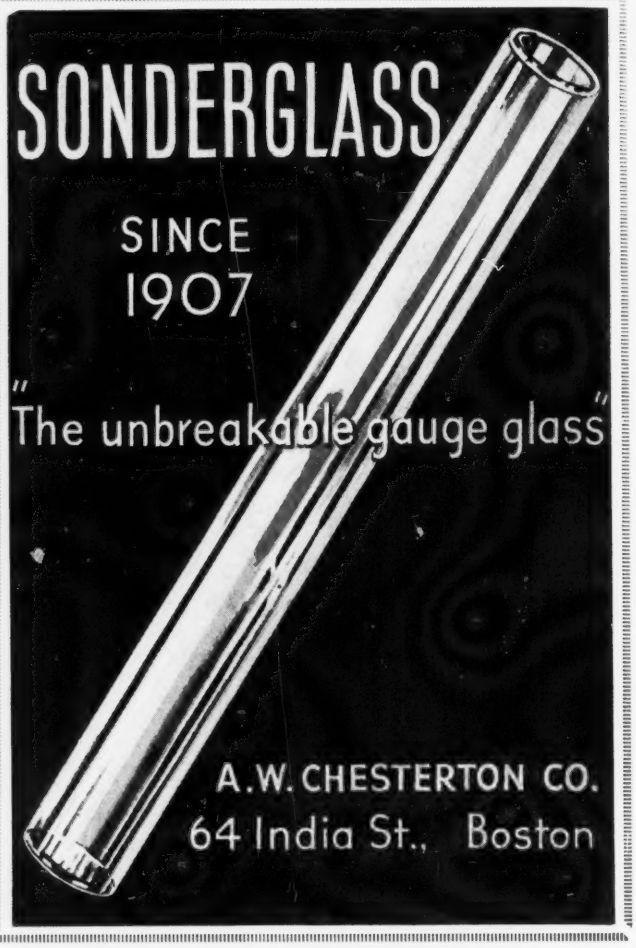

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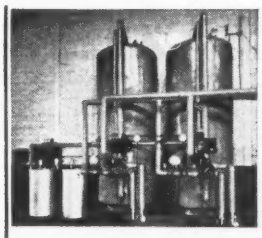

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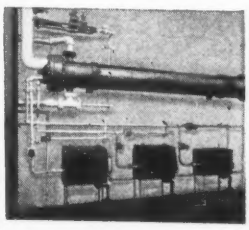

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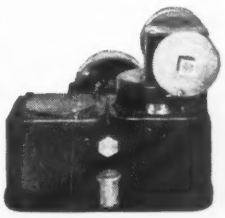

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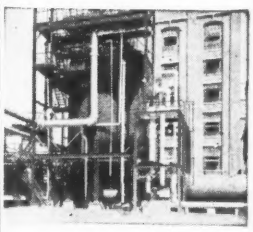

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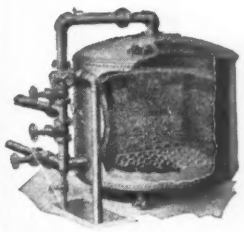

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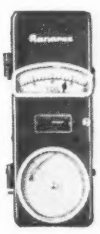

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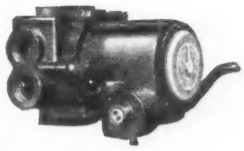

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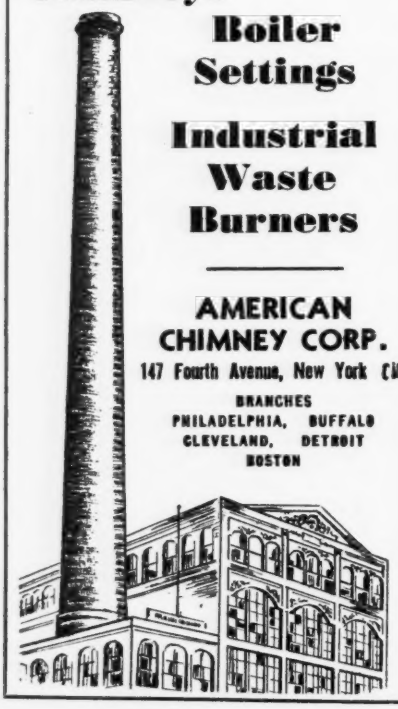

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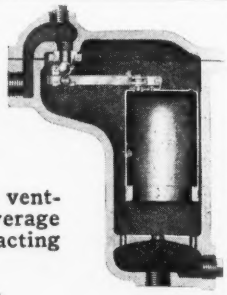

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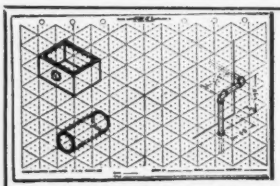

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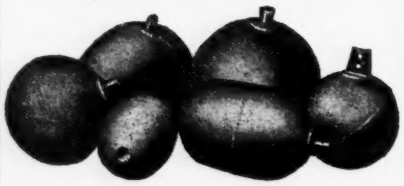

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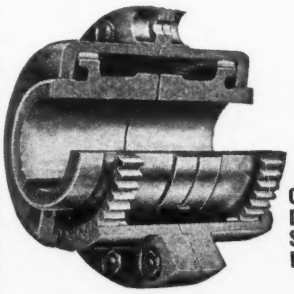

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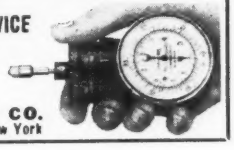

Read Speeds at leisure:
R.P.M., F.P.M. Also
Speed Fluctuations.
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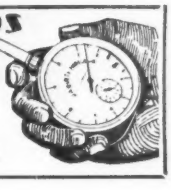
O. ZERNICKOW CO.
21 Park Row New York

MEASURE SPEEDS with the S&S SPEED INDICATOR



George Scherr Co., Inc.
128 Lafayette Street, New York, N. Y.

AUTOMATIC PRESSURE CONTROL

For service on steam, liquid or gas where pressures range from ounces up to 5000 pounds per square inch.

Illustrating four Foster relief valves and one regulating valve selected from the various types manufactured.

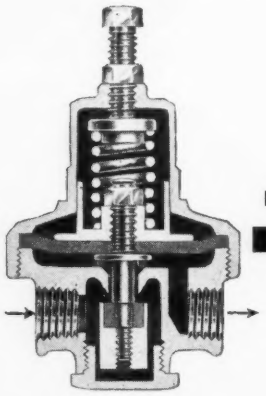


Figure 1

Fig. 1. One of the several modifications of Type Y Foster Regulating Valves. These Y Valves are extremely sensitive and are recommended for use on steam, liquids and gases where the volume is small and the initial pressures are variable. Initial pressures range up to 3,000 pounds; delivery pressures from ounces to 250 pounds. Single-stage reduction. Sizes ½″ to 2″.

Fig. 2. Class G, single-seated, auxiliary operated for severe and intermittent service on air, saturated or superheated steam. Wide spring ranges for pressure adjustment 25 to 300 pounds. Sizes ½″ to 12″. Standard construction all-bronze ½″ to 12″. Semi or cast-steel 1¼″ to 12″.

Fig. 3. Class 34R, direct-acting type, single-seated relieves hydraulic or gas pressures up to 4,000 pounds. Ruggedly constructed with special metal alloy seat and disc. Sizes ¼″ to 4″, screwed or flange connections.

Fig. 4. Class 34R10, direct-acting with outside lever for manually lifting valve disc from its seat, for relieving steam or gas pressures. Particularly adapted for oil refinery service on oil, gas or other liquids and steam. Sizes ½″ to 6″, angle or globe, screwed or flange connections. Semi and cast-steel special alloy internal parts.

Fig. 5. Class S single-seated, direct-acting, diaphragm operated for deadend service on steam, water, oil, gas, etc. Standard construction. Sizes ½″ to 1″. All-bronze 1¼″ to 2″. Bronze internal trim body and 2½″ to 4″, semi-steel bronze trim. All sizes can be constructed of semi or cast-steel with special metal alloy internal parts.

Place your Relief Valve problems before our staff of experienced engineers for types, sizes and application. Also any other automatic control problem to be solved in your plant. Write us in detail.

FOSTER ENGINEERING COMPANY

108 Monroe St., Newark, N. J.

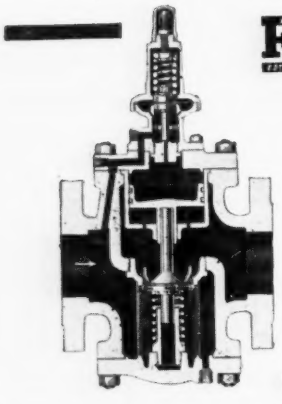


Figure 2

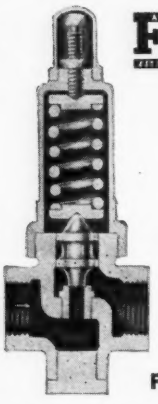


Figure 3

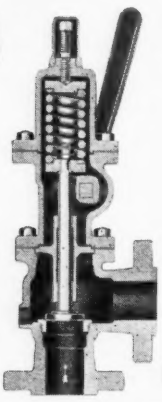


Figure 4

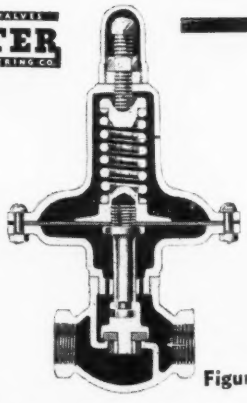


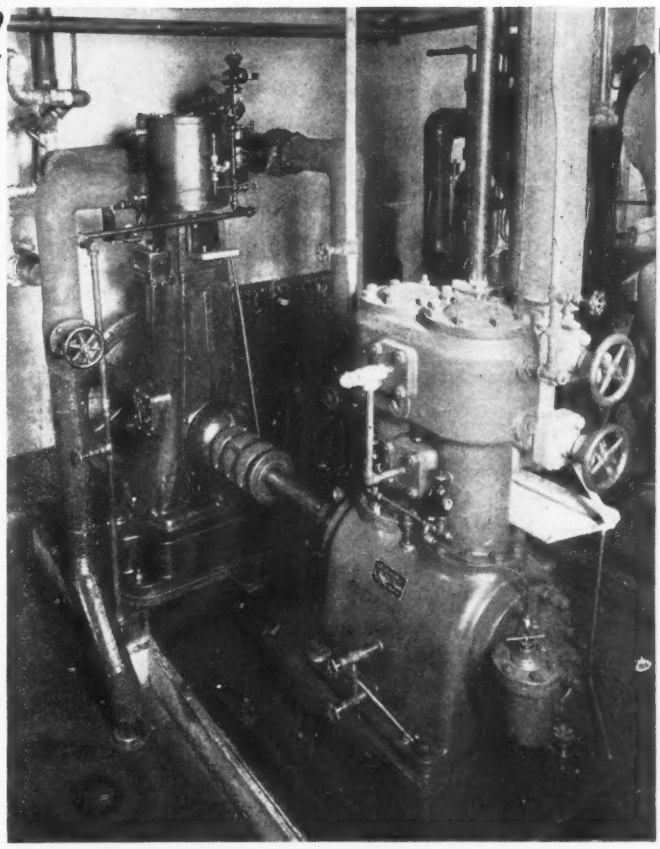
Figure 5

LOOSE MONEY

—would you pass it by?

If you saw a dollar bill lying on the sidewalk — and it wasn't April 1st—would you pick it up? And supposing there were two of them — would you leave one?

Many a concern this year has, through a *Troy-Engberg Steam Engine*, picked up not only one dollar that was lying around loose but two, three and many more. The first dollar represents savings gained by modernization. Probably any new drive would bring this about. The additional dollars represent the extra savings — By-Product Power savings — as applied through the modern Troy-Engberg Steam Engine. Under many conditions, this unit will deliver in its exhaust — oil free, if necessary — all the steam required for processing or heating and produce maximum By-Product Power *at the lowest cost.*



A typical Troy-Engberg By-Product Power installation—a 10x8 Type E steam engine recently installed for driving a refrigerating compressor with the exhaust steam used for heating.

If you use steam in your plant in any way, you are a potential user of a Troy-Engberg Steam Engine or Engine-generating set. Why not write for an illustrated folder telling how typical concerns are saving hundreds of dollars through By-Product Power Savings?

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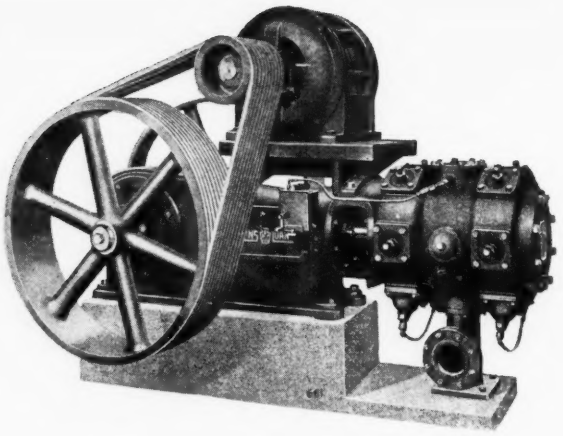
1413 RAILROAD AVENUE, TROY, PENNSYLVANIA

TROY-ENGBERG

HORIZONTAL AND VERTICAL STEAM ENGINES • A. C. & D. C. GENERATING SETS

When Better Pumps and Compressors are required, specify

PENNSYLVANIA



Twenty Pennsylvania single-stage, horizontal air compressors serve 10 plants of a large manufacturing industry. They were installed between 1927 and 1930. Record up to December 1, 1935 shows that all 20 machines have been maintained in splendid operating condition at an average cost for replacement parts of approximately $3.00 per year for each compressor.

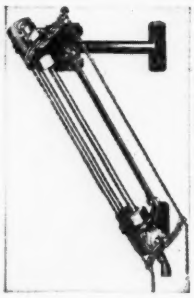
Send for Descriptive Compressors Bulletins 160-P and 164-P.

PENNSYLVANIA PUMP & COMPRESSOR CO.
EASTON, PENNA.

"PBH" WATER GAUGES and GUAGE GLASS PROTECTOR

Quick Closing

Quadruple thread, opened or closed from floor by pull of chain, less than one quarter turn. Instant action—no scalds, no burns. Available in flanged patterns for high pressures.



Tiltview

Sure sight at any height. Observer stands directly under column, assuring instant and accurate control of water. Available in screwed type.

Shatter-Proof

Gauge glass protector prevents glass flying if gauge glass fails. Certain protection and absolute visibility guaranteed. Easily installed. Fits any make of water gauge.

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CHEMICAL plant works engineer. Twenty years' experience power plant construction and operation. Graduate mechanical and electrical. Available for connection with industrial or power plant. Fine record. PW-483, Power, 330 West 42d Street, New York City.

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SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 25 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If you have actually earned over $2,500, send only name and address for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo, N. Y. (P.)

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ELECTRIC power equipment catalogue, List No. 77, 4"x9", 36 pages, illustrated, classified, priced and indexed. Write to George Sachsenmaier Co., 8400 Hegerman St., Holmesburg, Philadelphia, Pa.

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RW-514, Power
330 W. 42d St., New York City

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SCRANTON, PA.

Advertising of
USED EQUIPMENT
FOR SALE
See pages 85-90
WANTED
See page 90

Representation Offered

A highly trained electrical and mechanical engineer with twenty-two years' experience contacting New England industrials, desires the selling rights to engineering specialties such as: Small engine generator units, process control equipment, pumps and blowers for material handling, power factor corrective apparatus, electric hoists and overhead conveying systems, or similar and allied products.

RA-515, Power
330 West 42nd Street, New York City

RE-NU-BILT BELYEA MOTORS

POWER EQUIPMENT

for prompt delivery

GUARANTEED RE-NU-BILT

This partial list of carefully re-built, inspected equipment represents but a small part of our enormous stock available for immediate delivery.

D.C. MOTORS

ADJ. SPEED, 230 V.

H.P.	QTY.	MAKE	TYPE	SPEED
1500	1	West.	QM	470/600
410	1	West.		1000/1200
250	1	El. Dy.	BB	300/900
410	1	Cr. Wh.	CMC	1000/1200
120	3	G. E.	DMC	300/800
120	2	G. E.	RF-18	400/1000
100	1	West.	SK-200	365/600
100	1	Reliance		575/1150
80	3	Diehl	K11-40	500/1100
75	1	G. E.	RF-17	300/900
50	2	West.	SK-190	225/600
50	1	Cr. Wh.	EM	175/700
40	1	West.		300/900
35	1	West.	SK	500/1500
35	1	Cr. Wh.	CMC	800/1600
25	15	West.	SK-110L	650/2200
20	1	West.	SK-120	650/1300
20	2	West.	SK	375/1500
20	20	G. E.	LC	650/1950
20	1	West.	SK-110L	500/1500
20	1	G. E.	RF-12	500/1500
15	1	West.	SK-100L	600/1200
15	5	West.	SK-110L	400/1600
10	15	West.	SK-90	500/1500

D.C. MOTORS

CON. SPEED, 250 V.

H.P.	MAKE	SP.
410	West.	1000
250	Diehl	240
200	G. E.	475
125	Shaw	410
100	West.	850
100	G. E.	850
100	West.	850
75	West.	750
75	G. E.	500
50	G. E.	1750
50	West.	750
50	West.	565
40	G. E.	1100
40	G. E.	860
30	West.	1150
30	West.	975
25	West.	1150
25	G. E.	1150

D.C. GEN. 250 V.

KW.	MAKE	SP.
250	Cr. Wh.	1200
100	G. E.	375
100	West.	720
75	West.	900

MOTOR GENERATORS

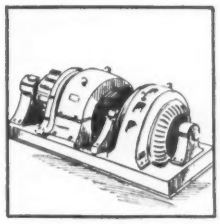
1000 KW. G. E. M.P.C. 275 V. D.C. Gen. Conn. to 1440 H.P. G. E. ATI, 4600, 2300 V., 514 R.P.M., 3 Ph., 60 Cy.

500 KW., G. E. M.P.C., 250 V D.C. Gen. Conn. to 700 KVA. G. E. ATI, 2200/4000 V., 900 R.P.M.., 3 Ph., 60 Cy.

300 KW., West. 250 V., D.C. Gen. Conn. to 433 H.P. West. Synch. Motor 4600/2300 1200 R.P.M., 3 Ph., 60 Cy.

200 KW., Crocker Wheeler, 149 DA., 250 V. D.C. Gen. Conn. to 300 H.P. Sq. Cage Motor 2300/220 V., 575 R.P.M., 3 Ph., 60 Cy.

175 KW., G.E. 275 V., D.C. Gen. Conn. to 290 H.P. Synch. Motor 2300/440 V., 720 R.P.M., 3 Ph., 60 Cy.



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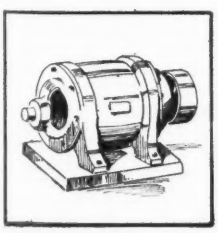


A.C. MOTORS

3 PH., 60 CY.
SYNCH. TYPE

H.P.	MAKE	SPEED
2850	G. E.	450
600	G. E.	257
225	El. Mach.	450
67½	G. E.	1200
50	G. E.	1200
35	G. E.	1200

SLIPRING TYPE

H.P.	MAKE	SPEED
600	G. E.	257
600	G. E.	705
450/360	West.	875/700
400	West.	514
400	G. E.	885
300	G. E.	575
300	Al. Ch.	585
250	F. Morse	1200
250	West.	700
250	G. E.	257
200	West.	900
200	G. E.	900
150	G. E.	1750
150	G. E.	870
100	G. E.	700
100	F. Morse	1175
100	West.	1160
100	Wagner	850
90	Wagner	650
90	G. E.	720
75	G. E.	690
75	G. E.	865
75	G. E.	1200
60	G. E.	600
60	G. E.	860
60	G. E.	900
50	G. E.	1750
50	West.	690
50	West.	850
50	West.	580
50	G. E.	1200
50	G. E.	865
50	West.	1200
50	West.	1800
40	G. E.	1200

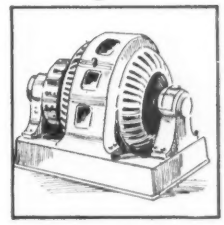
SLIPRING

25 CY., 3 PH.

H.P.	MAKE	SPEED
300	West.	490
150	G. E.	500
100	West.	375
100	G. E.	375
50	West.	715
35	G. E.	500
25	West.	480
25	West.	730

A.C. GENERATORS

KVA.	MAKE	VOLTS	SPEED
937	Al. Ch.	2300	450
750	West.	480	3600
450	Al. Ch.	2300	240
100	Western	480	900
100	West.	2300	900
75	G. E.	2300	900
56	G. E.	2300	1200



SQ. CAGE TYPE

H.P.	MAKE	SPEED
300	Cr. Wh.	580
250	West.	580
200	West.	1160
150	G. E.	900
125	West.	900
125	West.	1150
100	G. E.	900
100	West.	700
75	West.	870
75	West.	600
75	G. E.	720
60	G. E.	1760
50	West.	1200
50	G. E.	870

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500 KW. G. E. type HCC, 250 V.D.C., 6 Ph., 60 Cy., 1200 R.P.M. Complete with 13200/6600 Volt, transf.

150 KW., G. E. Type HCC, Form P, 6 Ph., 1200 R.P.M., 250 V. D.C. Complete with transf. & S/B.

50K W., Martin Type 6H9, 3 Ph., 1200 R.P.M., 90/115 V.D.C. Completewithtransf. & S/B.

TRANSFORMERS

SINGLE PHASE, 60 CY.

KVA.	MAKE	TYPE	VOLTAGE
4—1000	G. E.	OC	66,000-13200/2300
3— 500	G. E.	H	13,200-2300/4000
3— 500	West.		2400-120
2— 200	Packard		2300-110/220
3— 150	G. E.		7650/13200-230/460
3— 75	G. E.		2400-4160Y-120/240
3— 75	G. E.		2300-230/115
3— 25	Packard		4150-120/240

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1—1500, 1—3250 KVA Allis Chalmers, condensing, 3 phase, 60 cycles, 2300 volts; 1—750 G. E. condensing units.
1—300 KW Allis Chalmers, 3 phase, 60 cycles, 2300/440 volts, Generator only, 3600 R.P.M., exciter on shaft, base and couplings and oiling system complete, suitable for direct connection to turbine.

A. C. GENERATORS

1—2500 KVA, 3 phase 60 cycles, 6600/2300 volts, Westinghouse Alternator, 360 R.P.M.—spare for frequency changer, has long base and shaft, bearings complete, in service less than a year, can be changed to 2860 H.P. Motor—making it suitable to drive 1500—2000 KW. D.C. motor generator set.
1—300 KW, G.E., 3 ph., 60 cy., 2300/440/220 v., 3 bearing, 450 R.P.M.; 1—200 KW, 3 ph., 60 cy., 2300/440/220 v., 3 bearing, G.E., 600 R.P.M.; 1—75 KW, 3 ph., 60 cy., 2300/440/220 v., G.E., 1200 R.P.M.; 2—150 KW, 600 R.P.M.

ENGINE DRIVEN A. C. and D. C. UNITS

AC 2—200 KW, 3 phase, 60 cycles, 440/220 volts G.E., 4 valve, 200 R.P.M. unit. 1—150 KW, 1—100 KW, 1—75 KW, 3 phase, 60 cycles, 220 volts.
DC 1—200 KW, 220 volts; 1—100 KW, 3 wire units; 2—100 KW, 3 wire Marine type units; 1—50 KW, 250 v. Marine type; 1—50 KW, 110 v. Marine type. All G.E. units.

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3—Dry back Marine—175 lbs. pressure, 300 HP, self contained.
2—Kennedy Van Saun Coal Pulverizing units complete—explosion proof motors. Plant equipment consisting of Centrifugal driven pumps, heaters, steam driven pumps, accessories.

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4—400 KVA—1560—13,200—6600—480—240 single phase.
3—1250 KVA—13,200—6600—480—240.
3—3,000—15,600—13,200—2300—4150 sgl. ph.
A full line of Distribution and Power Transformers, Switchboard Apparatus, Circuit Breakers, Current and Potential Transformers, Relays, Volt Meters, Ammeters, etc.

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225 West 34th St., New York, N. Y.
Largest Dismantling Engineers in the East of Industrial and Power Plant Equipment.

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Rotary Converters	Air Compressors
Turbo Generators	Transformers
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Motors, Generators, Pumps, Compressors and Machine Tools.

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148 N. 3d St. Philadelphia, Pa.

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ELECTRICAL BARGAINS

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1—125 hp. Westinghouse Synchronous motor, 1800 r.p.m., 4000 volt, direct-connected, exciter. New in 1932 ..... $350.00
1—25 kw., 125 volt D.C. Westinghouse SK100L M.G. set. Motor CS, 40 hp. 3/60/440 volt, 3-bearing set, A-1 condition $250.00

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Electric Motors
TOLEDO, OHIO

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1—200-kw., 250/125-V., Westinghouse Synchronous.
1—200-kw., 125-V., G. E., Synchronous.
1—175-kw., 250-V., Crocker-Wheeler, Sq. Cage.
2—150-kw., 125-V., G. E., Synchronous.
1—150-kw., 250-V., Westinghouse Synchronous.
2—150-kw., 250-V., G. E. Synchronous.
2—125-kw., 125/250-V., G. E., Sq. Cage.
1—125-kw., 250-V., G. E., Synchronous.
1—100-kw., 125-V., G. E., Synchronous.
1—100-kw., 250-V., Westinghouse Synchronous.
1—75-kw., 125-V., Crocker-Wheeler, Synchronous.
1—75-kw., 250-V., G. E., Synchronous.
1—50-kw., 250-V., Westinghouse, Synchronous.
1—50-kw., 125-V., G. E., Sq. Cage.
1—50-kw., 250-V., G. E., sq. Cage.

TURBINES

1—1500-kva., 3-ph., 60-cy., 2300-V., Condens. Whse.
1—1000-kw., 3-ph., 60-cy., 2300-V., Whse. Bleeder.
1—750-kw., 3-ph., 60-cy., 480-V., Non-Condens. Whse.
1—625-kw., 3-ph., 60-cy., 480-V., Bleeder Whse.
1—625-kw., 3-ph., 60-cy., 480-V., Non-Condens. Whse.
1—100-kw., 3-ph., 60-cy., 240-V., Non-Cond., G. E.
1—50-kw., 125-V., G. E.-Kerr.
1—15-kw., 125-V., G. E.-Terry.

TRANSFORMERS

3—500-kva., Wagner, 2400/240/480-V.
3—300-kva., 3-ph., Pittsburgh, 4800/2400/240/120-V.
2—200-kva., G. E., 4150/220/110-V., Scott Taps.
4—100-kva., Westinghouse, 2200/440/220/110-V.
3—100-kva., G. E., 7800/440/220-V.
1—75-kva., G. E., 480/110/220-V.
1—25-kva., G. E., 220/220/110-V.
1—20-kva., Moloney, 440/220/110-V.
1—15-kva., G. E., 220/220/110-V.

MOTORS—3 PHASE, 60 CYCLES

No.	H.P.	R.P.M.	Volts	Type
1	1000	400	Any Voltage	G. E. Sl. Rg.
1	800	180	6600	West. Syn.
1	500	720	4000	G. E. Sl. Rg.
1	500	450	2200/4000	G. E. Sl. Rg.
1	500	900	440/4000	West. Syn.
1	450	400	2200	G. E. Syn.
1	400	514	2200	West. Sl. Rg.
2	300	450	220/440	Ridgeway Syn.
1	300	225	2300	West. Syn.
2	200	900	440	G. E. Sl. Rg.
2	200	514	220/440/4000	G. E. Syn.
4	200	450	2200/4000	G. E. Sl. Rg.
2	200	514	2200/4000	G. E. Sl. Rg.

Variable Speed 230 Volt Motors

Hp.	R.p.m.	Type
200	275/550	G.E.
125	475/950	Westinghouse
90	470/940	G.E.
80	120/850	Burke
35	500/1500	G.E.
35	500/1250	G.E.
35	350/1050	El. Dynamic
30	600/1200	West.
30	300/1200	El. Dynamic
25	300/900	El. Dynamic
25	300/600	El. Dynamic
25	250/1000	El. Dynamic
20	750/1500	G.E.
20	375/1500	West.
20	400/1200	G.E.
4—20	300/1200	G.E.
3—15	300/1200	G.E.
15	300/600	El. Dynamic

Complete Line of A.C. and D.C. Motors and Generators

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A Complete Stock. **Prompt Shipment.**

3—500 KVA Pittsburgh Transformers, 60 cycle, 6900/13800—220/440 volts. **$900.00 EACH**

We Rewind, Repair and Redesign all Makes and Sizes.
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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M CINCINNATI, OHIO

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TURBO GENERATORS

4000 kw. G. E. Cond., 3-60-6600 v.
1500 kw. G. E. Cond., 2-3-60-2300 v.
650 kw. West. Non C., 550 v. A.C., 250 v. D.C.
500 kw. G. E. Cond., 3-60-2300 v.
300 kw. Allis, Cond., 3-60-550 v.
50 kw. West. Non C., 3-60-480 v.

BOILERS

407 hp. Edge Moor, 200 lbs.
300 hp. B & W (Mass.) 160 lbs.

AIR COMPRESSORS

2—92 cu.ft. I.-R. ERI, 7x6 Belted, 100 lbs.
1—617 cu.ft. I.-R., 17x10 Belted, 25 lbs.
1—599 cu.ft. I.-R. 2 Stage, Belted, 100 lbs.
4—640 cu.ft. Sull. Angle, Belted, 100 lbs.
1—750 cu.ft. Sull. Angle, Belted, 100 lbs.
1—789 cu.ft. I.-R., 2 Stage, Steam, 45 lbs.
2—1775 cu.ft. I.-R., Belted, 25 lbs.
6—1955 cu.ft. I.-R. XPR3, Steam, 100 lbs.
1—2588 cu.ft. I.-R. OC3, Steam, 110 lbs.

1—Motor Gen. 75 kw., 2300 v./125 v.

A. Lee Ellis Co., U. S. Mchy. Bldg., Boston, Mass.

The Buyer Must Be Satisfied—Always

SYNCHRONOUS MOTORS

AVAILABLE FROM STOCK

BUILT 1926—USED LESS THAN ONE YEAR

18 DUPLICATE, 175 hp., 2200 volt, 100% P.F., 60 cycle, Westinghouse, 150 r.p.m., 40° C., Synchronous Motors. Originally designed for rod mill drive. Reconnect as 125 kva. 220/440 volt generators. WIRE—WRITE.

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MECHANICAL ELECTRICAL
2501 EAST 52nd STREET LOS ANGELES, CALIF.

Joe, Chief Engineer: (All excited) "Listen Bill, we're in a jam. The big motor's burned out an' we've got to have another one quick. What can we do?"

Bill, Plant Manager: "Keep your shirt on, my boy. I've already had Sachsenmaier on the phone. They've got just what we want in stock; and it'll be here by truck before morning."

Joe: "You must have a lot of faith in that outfit."

Bill: "I'll say I have. We've been doing business with them for 30 years an' they never failed us yet. When *they* list a piece of equipment, they've got it on their floor—not under option out in some other state."

MOTOR GENERATOR SETS

500 K.W., 250 volt, type MPC Gen. Elec. to 850 H.P. A.C. synch. motor.
150 K.W., 250 volt, type SK Westgh. to 220 H.P. A.C. synch. motor.
100 K.W., 250 volt, type SK Westgh. to 150 H.P. A.C. synch. motor.
100 K.W., 230 volt, Crocker-Wheeler to 135 K.V.A. A.C. synch. motor.
100 K.W., 250 volt, type RC, Gen. Elec. to 150 H.P. A.C. induct. motor.
52 K.W., 65 volt, Western Elec. to 82 H.P. A.C. induct. motor.
50 K.W., 125 volt, type SK Westgh. to 75 H.P. A.C. synch. motor.
30 K.W., 12 volt, American Giant gen. to 50 H.P. Crocker-Wheeler induct. motor.
30 K.W., 250 volt, Diehl gen. to 50 H.P. Wagner A.C. induct. motor.
25 K.W., 125 volt, type CD Gen. Elec. to 40 H.P. A.C. induct. motor.
15 K.W., 250 volt, type SK Westgh. to 25 H.P. A.C. induct. motor.

A.C. GENERATORS
Engine Driven & Belt Drive

850 H.P., 3 phase, 25 cycle, 6600 volt, 300 R.P.M. Westgh.
600 K.W., 3 phase, 60 cycle, 2300 or 550 volt, 450 R.P.M. Gen. Elec.
600 K.W., 3 phase, 60 cycle, 600 volt, 400 R.P.M. Gen. Elec.
400 K.V.A., 3 phase, 60 cycle, 240 volt, 150 R.P.M. Westgh. to 26x30 Erie Ball Engine.
325 K.V.A., 3 phase, 60 cycle, 2300/-480/240 volt, 200 R.P.M. Allis-Chalmers to 21x22 Skinner unaflow engine.
200 K.W., 3 phase, 60 cycle, 220/-440/600 volt, Gen. Elec. 600 R.P.M.
156 K.V.A., 2 phase, 60 cycle, 220 volt. Allis-Chalmers to 14x16 Skinner unaflow.
150 K.V.A., 3 phase, 60 cycle, 440 volt, Westgh., 200 R.P.M.
150 K.V.A., 3 phase, 60 cycle, 2400 volt, 900 R.P.M. Westgh.

A.C. GENERATORS (cont.)

125 K.V.A., 3 phase, 60 cycle, 2300 volt, 900 R.P.M. Westgh.
120 K.W., Western Elec. (G. E.), 3 phase, 60 cycle, 220 volt, 900 R.P.M.
99 K.V.A., 3 phase, 60 cycle, 440 volt, 720 R.P.M. Gen. Elec.
75 K.W., 2 phase, 60 cycle, 2300 volt, 900 R.P.M. Gen. Elec.
75 K.V.A., 3 phase, 60 cycle, 220 volt, 1200 R.P.M. Gen. Elec.
50 K.W., 2 phase, 60 cycle, 240 volt, 1200 R.P.M. Gen. Elec.
50 K.V.A., 3 phase, 60 cycle, 220/-440 volt, Fort Wayne, 1200 R.P.M.
40 K.V.A., 3 phase, 60 cycle, 2300 volt, 1200 R.P.M. Fairbanks-Morse.
31.3 K.V.A., 3 phase, 60 cycle, 240 volt, 450 R.P.M. Gen. Elec.
25 K.V.A., 3 phase, 60 cycle, 240 volt, 450 R.P.M. Gen. Elec.
12.5 K.W., 3 phase, 60 cycle, 220 volt, 1800 R.P.M. Gen. Elec.
7½ K.V.A., 3 phase, 60 cycle, 600 R.P.M. Gen. Elec.
5 K.V.A., 3 phase, 60 cycle, 220 volt. Kohler gen. to Kohler gasoline engine.

SPECIALS

2—1250 K.W., 1563 K.V.A., General Electric extraction turbines connected to 3 phase, 60 cycle generators with direct connected exciters, surface condensers, etc.

1—1500 K.W., 1875 K.V.A., General Electric extraction turbine connected to 3 phase, 60 cycle generator.

2—100 H.P., 3460 R.P.M., Westinghouse motors to 250 gallon, 990 ft. head Worthington boiler feed pumps.

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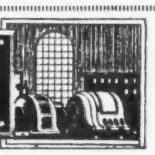

SLIP RING MOTORS
3-PH., 60-CY.

HP	*Volts*	*Make*	*Speed*
200	2200–440–220	G.E.	600
150	2200–440–220	G.E.	514
150	2200–220–440	G.E.	720
150	220–440–550	G.E.	600
100	2200–440–220	Whse.	1,200
100	550	Wagner	720
100	2200–550	Whse	900
100	440–220	G.E.	720
100	550	G.E.	900
100	220–440	G.E.	900
75	440–220	G.E.	900
75	220–440	G.E.	720
60	2200	G.E.	600
50	2200	G.E.	1,200

SYNCHRONOUS MOTORS
3-PH., 60-CY.

300	2300	G.E.	1,200
240	2300	G.E.	900
240	2200–440–220	G.E.	600
220	2300	G.E.	720
200	440–220	Whse.	900
200	2200/4000	G.E.	514
80	440–220	G.E.	1,200
80	550	Whse.	900

A. C. GENERATORS

1—300 kva., 900 r.p.m., 240-480-V., Al. Chal.
1—300 kva., 720 r.p.m., 2300-240-480-V., G.E.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—225 kva., 900 r.p.m., 2300-V., G.E.
1—200 kva., 900 r.p.m., 240-480-V., Whse.
1—112½ kva., 1200 r.p.m., 2200-480-V., G.E.
1—100 kva., 900 r.p.m., 2300-V., Whse.
2—100kva.,900r.p.m.,240-480-V.,Crocker-Wheeler.
1—75 kva., 1200 r.p.m., 240-480-V., G.E.
1—75kva.,1200r.p.m.,240-480-V.,Crocker-Wheeler.
1—75 kva., 900 r.p.m., 600-V., Whse.

DIRECT CURRENT MOTORS

HP	*Volts*	*Make*	*Type*	*Speed*
250	230	G.E.	MPC	700
100	230	Whse.	SK	625
100	230	G.E.	LC	1,150
80	230	G.E.	RC	600
50	230	G.E.	CD	1,150
40	230	G.E.	RC	750

SQUIRREL CAGE MOTORS

HP	*Volts*	*Make*	*Type*	*Speed*
300	2300	G.E.	KT	1,200
250	440–550	G.E.	IE	1,200
150	2200–440–220	G.E.	IK	720
100	550	G.E.	KT	900
100	220–440	G.E.	KT	900
100	2200	G.E.	KT	1,800
75	220–440	G.E.	KT	720
75	220–440	G.E.	KT	900
50	2200	G.E.	IK	514

MOTOR GENERATOR SETS

1—250-kw., 250-V., 1200 r.p.m., G.E., type MPC., connected to type ATI, 435, hp., .8 PF-2300/4000-V., 60 cy., syn. motor.
1—200-kw., 250-V., 1200 r.p.m., G.E., type MPC., connected to type TS, 350 hp., .8 PF-2300/4000-V., 60 cy., syn. motor.

TRANSFORMERS—60 CYCLE

3—500 kva., Allis-Chalmers 13200-230/460.
3—250-kva., G.E. type H-KDD 13800-230/460.
3—200 kva., Whse., type S-K, 6600/13200-2300.
2—200 kva., Whse., type S-K, 4800/4106/3600/2400-480/240/120.
3—150 kva., G.E., type H-KD 4000-230/460.
3—150 kva., Allis-Chalmers 6900/13800-220/440.
3—100 kva., G.E., type H-KS, 2300/4000Y-230/460.
3—75 kva., G.E., type H-KS, 2200-110/220.
1—75 kva., G.E., type H-KS, 4800/2400-240/208/120.
3—50 kva., G.E., type H-K, 2200-220/110.
3—50 kva., Whse., type SK, 13800-120/240.
3—25 kva., G.E., type H-K, 2300-230/460.

GUARANTEED SOUND VALUES

2—650/800 G.P.M., 330/280 ft. HD. Bronze Fitted Pumps with 100 hp., 3/60/2200 v. motors and control.
1—360 C.F.M., 100 lb. Compressor, M.D.
1—485 C.F.M., 50 lb. Compressor, M.D.
1—311 C.F.M., 30 lb. Compressor, M.D.
2—30 kva., 2200 volt Indoor Capacitors.
1—50 kva., 3/60/220 volt, 8 P.F. Alternator.
1—125 kva., 3/60/220 volt, 8 P.F. Alternator.
1—150 hp., 150 lb. Erie City HRT Boiler.
1—50 hp., 230 v. D.C., 1700 R.P.M. Pump Motor.
1—100 hp., 230 v. D.C., 1700 R.P.M. Pump Motor.
1—60 hp., 3/60/220 v., 1200 R.P.M. Synch. Motor.
2—50 hp. Single Drum Mtr. Driven Hoists.
1—50 hp. Double Drum Mtr. Driven Hoist.

Particulars on Application

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A. S. M. E. BOILERS

2—200 hp. Keeler H.R.T. 150 lb. press.
1—150 hp. Coatesville H.R.T., 150 lb. press.
1—150 hp. Coatesville H.R.T., 125 lb. press.
1—100 hp. Erie Economic, 100 lb. press.
1— 80 hp. Erie Economic, 125 lb. press.
Also other types and sizes in stock.

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5000-kw. General Electric Condensing Turbo Generator, 200 lbs., 3 phase, 60 cycle, 2300 volt, new 1920.

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Inspection guaranteed. All types and sizes, ready for immediate delivery. We can fill your requirements at the lowest possible price.

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Over 10,000 items in stock for immediate delivery—Rochester, N. Y., or Toledo, Ohio, shipment. Rebuilt equipment sold with standard new guarantee. We buy used equipment—25 and 60 cycle—send us your offerings.

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DEPENDABLE APPARATUS AT PRICES REPRESENTING A SUBSTANTIAL SAVING

1000 KW. G. E., 250 v., direct current interpole generator direct connected 1400 H.P., type ATI, 3 ph., 60 cy., 6600 v. synchronous motor.

937½ K.V.A. WESTGH., 3 ph., 60 cy., 2300 v., 300 R.P.M. alternating current generator direct connected 1280 H.P., 3 ph., 25 cy., 4000 v., synchronous motor.

750 K.W. ALLIS, 3 ph., 60 cy., 480 v., 3600 R.P.M. condensing turbo generator unit—complete.

375 K.V.A. G. E., 3 ph., 60 cy., 2300 v., 3600 R.P.M. turbo generator unit equipped with direct connected exciter and surface condenser.

312 K.V.A. WESTGH., new 3 ph., 60 cy., 2300 or 440 v., 200 R.P.M. alternating current generator equipped with amortisseur windings.

312 K.V.A. ALLIS, 3 ph., 60 cy., 2400 v., 150 R.P.M. generator direct connected 20"x32" Nordberg Unaflow engine.

250 K.V.A. G. E., type ATI, 3 ph., 60 cy., 240 v., 720 R.P.M. belted type generator.

200 K.W. G. E., 125 v., direct current interpole generator direct connected 300 H.P., 3 ph., 60 cy., 2200 v., squirrel cage induction motor.

200 K.W. G. E., 250 v., 580 R.P.M. compound wound belted type direct current generator.

187 K.V.A. WESTGH., 3 ph., 60 cy., 2300 v., 225 R.P.M. generator direct connected Skinner frame IB Unaflow non-condensing engine.

150 K.V.A. W. E., 3 ph., 60 cy., 240 v., 200 R.P.M. generator direct connected 16"x19" Chuse non-releasing, non-condensing engine.

150 K.V.A. G. E., 3 ph., 60 cy., 600 v., 225 R.P.M. generator direct connected 16"x16" Skinner counterflow non-condensing engine.

150 K.V.A. ALLIS, 3 ph., 60 cy., 240 v., 257 R.P.M. generator direct connected 180 H.P., style VA vertical Fairbanks-Morse Diesel engine.

156 K.V.A. ALLIS-TERRY, 3 ph., 60 cy., 220 v., 3600 R.P.M. non-condensing turbo generator unit complete direct connected exciter, switchboard and instruments.

94 K.V.A. G. E., 3 ph., 60 cy., 240 v., alternating current generator direct connected to Skinner Unaflow non-condensing engine complete.

80 H.P. G. E., type ATI, form PC, 3 ph., 60 cy., 440 v., 720 R.P.M. synchronous motor complete with direct connected exciter.

65 K.W. G. E., 125 v., 1100 R.P.M. direct current generator direct connected Terry non-condensing turbine.

3—50 H.P. G. E., type KT-343, 3 ph., 60 cy., 440 v., 1200 R.P.M. squirrel cage motors.

22 H.P. NEW G.E., 3 ph., 60 cy., 440 v., 1200 R.P.M., type ITC totally enclosed slip ring motor.

20 H.P. NEW G. E., type RC-10, 250 v., 1150 R.P.M. 20 minute rating direct current motor.

2—10 H.P. NEW NORTHWESTERN, 230 v., 1150 R.P.M. 120 minute rating totally enclosed direct current motors.

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120 HP Fairbanks Diesel with clutch.
180, 240, 360, 560 HP 3/60/2300 v. Fairbanks Morse Diesel Generator Sets.
4 Unit—2000 KW Diesel Generating Plant.
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100 KW to 5000 KW Steam Turbo Units.
3—1040' Diesel Driven Air Compressors.

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ONLY A PARTIAL LIST OF OUR TREMENDOUS STOCK

A. C. GENERATORS

	Make	Speed
200 kw.	G. E.	600
150 kw.	Al. Ch.	900
150 kva.	G. E.	900
120 kw.	G. E.	720
100 kva.	West.	1200
90 kw.	G. E.	1200
85 kw.	West.	720
75 kw.	G. E.	1200
75 kva.	G. E.	1200
65 kw.	G. E.	1200
62½ kva.	Cr. Wh.	1200
50 kw.	G. E.	720
50 kw.	G. E.	1200
45 kva.	G. E.	1200
37½ kva.	Cr. Wh.	1200
30 kva.	West.	1200

SLIPRING MOTORS
3 phase, 60 cycle

Hp.	Make	Speed
200	F. M.	600
125	Cr. Wh.	600
100	Al. Ch.	900
100	G. E. MT.	900
100	G. E. MT.	720
100	F. M. hoist	720
80	G. E. MTC.	1200
79	West. hoist	1200
75	G. E. MT.	1200
75	G. E. MT. 558	900
75	G. E. MT	600
60	West. C. W.	300
50	G. E. MT. 346	900
50	G. E. MT. 352	720
50	Al. Ch.	600
40	Star	1800
40	West. CW	1200
40	West. CW	600

SQUIRREL CAGE
3 phase, 60 cycle

Hp.	Make	Speed
220	Cr. Wh.	720
150	G. E.	720
100	Al. Ch.	1800
75	Wagner	1200
75	G. E.	900
50	G. E.	1200
50	G. E.	900
40	Wagner	3600
40	G. E.	1800

110 V. D.C. MOTORS

75	G. E. RC	975
50	G. E. RC	1765
40	G. E. CD	400/600
35	West. SK	1150
25	West. SK	1400
25	G. E. CD	1150
20	G. E. RC	1150
15	G. E. RC	1750

D.C. MOTORS
230 VOLTS

Hp.	Make	Speed
100	West.	625
75	El. Dy.	700/1000
75	El. Dy.	400
60	G. E. RC	1050
60	G. E. RC	650
60	Diehl	500/1000
50	G. E. CD	1200
40	G. E. CD	850
35	Cr. Wh	325/1200
30	West. SK	850
25	West.	650/2200
15	West. SK	825/1650
15	West. SK	600/1500
10	Rel.	450/1800
10	G. E. RLC	400/1600
10	West. SK	400/1600
10	G. E. RLC	400/1600
9	G. E. RF	450/1800

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2—500 hp. **Stirling boilers,** A.S.M.E. code, superheaters, Taylor stokers.
2—350 hp. **Stirling boilers,** 160 lb., new tubes, hand fired.
1—407 hp. **Edgemoor boilers,** 200 lb. pressure, complete plant.
2—813 hp. **Edgemoor boilers,** 300 lb. pressure, complete plant.
2—354 hp. **Stirling boilers,** 200 lb. pressure, with superheaters, complete plant.
2—400 hp. **Heine boilers, Coxe stokers,** 165 lb. pressure, A.S.M.E. code.
4—665 hp. **B. & W. boilers,** water tube, 225 lb. Taylor stokers.
1—600 KW **Ames uniflow engine.**
1—125 KVA. **Ames uniflow engine.**
1—180 KW **Chuse uniflow engine generator set.**
1—300 KW **Chuse uniflow engine generator set.**
1—200 KW **Buckeye engine generator set.**

*The above is only a partial list.

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SYNCHRONOUS MOTOR DRIVEN AIR COMPRESSORS

Motors
Pumps
Boilers
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Machine Tools

NEVER USED

2032 cu.ft. Ingersoll-Rand Class PRE-2, 25 and 16¼ x 16, 75 lbs. pressure; direct connected to 300 hp. Westinghouse synchronous motor, 3/60/2200. With all equipment. New, in original crates.

1105 cu.ft. Ingersoll-Rand Class XRE-2, 19 and 12x12, 75 lbs. pressure; direct connected to 175 hp. Westinghouse synchronous motor, 3/60/2200; with all equipment. Never used.

OFFERED AT FRACTION OF NEW COST FOR IMMEDIATE DISPOSAL.

Generators
Turbines
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THE O'BRIEN MACHINERY COMPANY

113 North 3rd St., Philadelphia, Pa.

LARGE UNITS!

1—1150 CFM Bury Air Compressor.
1—250-hp. G. E. Synchronous Motor, 600 r.p.m.
1—150-hp. G. E. Synchronous Motor, 600 r.p.m.
1—30-hp. Fynn-Weichsell Motor, 1200 r.p.m.
1—125-hp. TRIUMPH Linestart Motor, 875 r.p.m.
1—300-hp. Allis-Chalmers Slipring, 514 r.p.m.
1—200-hp. BURKE Slipring, 900 r.p.m.
3—150-hp. G. E. Sliprings, 600 r.p.m.
1—100-hp. G. E. Vertical Slipring, 900 r.p.m.
1—650-hp. Crocker-Wheeler D.C. Motor, 575 r.p.m.
1—400-hp. Crocker-Wheeler D.C. Motor, 650 r.p.m.
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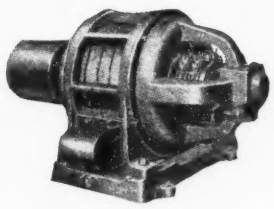

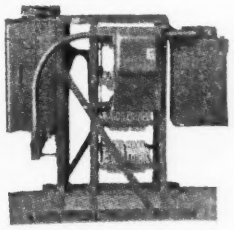

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We have in Indianapolis stock for spot shipment one hundred and fifty of the above motors, 75 hp. and 100 hp. General Electric Type KT and Westinghouse Type CS, all practically new motors, 220/440 volt—3 phase—60 cycle, 870 r.p.m. All complete with pulley and base. General Electric Type K or Westinghouse Type A Hand Compensators with overload relays and no voltage release. It is only occasionally that you have the opportunity to purchase motors like these in the used motor market. Our prices will surprise you and to dealers who are in a position to purchase for stock five or more we have an exceptional bargain.

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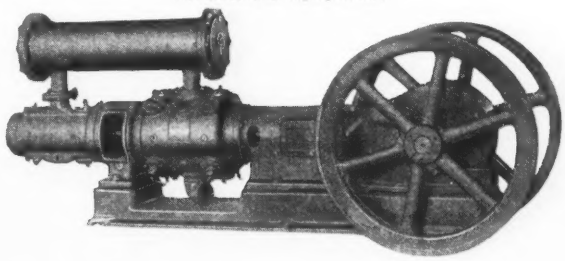

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Complete Shop Facilities

The best equipped shop for transformer and motor rebuilding in the South.

Speedy repairs and accurate work assures you complete satisfaction.

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1—500-kw., 250-volt, 1200 r.p.m., 6-phase, 60-cycle, **Westinghouse, Interpole, Rotary Converter,** with transformer and D.C. switchboard—complete.

1—250-hp., 580-r.p.m., 3-phase, 60-cycle, Type CS, **Westinghouse Motor.**

1—125-hp., 495-r.p.m., 3-phase, 60-cycle, Type CS, **Westinghouse Motor.**

1—75-hp., 490-r.p.m., 3-phase, 60-cycle, Type AN, **Allis-Chalmers Motor.**

1—35-kw., 125 V., D.C., 500 r.p.m., Type MP Generator to 50 hp., 220 V., 25 cycle, Type IK, **General Electric Motor.**

1—30-kw., 125 V., D.C., 720 r.p.m., Type SK Generator to 50-hp., 220 V., 25 cycle, Type CS, **Westinghouse Motor.**

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516 HP (2) ASME Stirling Boilers, 200 lb. pressure.
1563 KVA G.E. Condensing Turbo Unit, 200 lb. pressure, 2300 volts A.C.
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450 KVA Ames **Uniflow** Non-Condensing Unit, 150 lb. pressure, 2300/480/240 volts A.C.
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125 KVA Skinner **Uniflow** Non-Condensing Unit, 125 lb. pressure, 2300/480/240 volts A.C.
125 KW Skinner **Uniflow** Non-Condensing Unit, 140 lb. pressure, 125 volts D.C.
75 KVA Ames **Counterflow** Non-Condensing Unit, 120 lb. pressure, 240/480 v. A.C.
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Selected by Engineers—reconditioned consultation manufacturers. Advise any apparatus or equipment you have for liquidation.

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NEW MOTORS
Built in 1934
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1—200 H.P. Westinghouse Induction Motor, Type "CS", 3 Phase, 60 Cycle, 2200/4000 Volts, 1180 RPM.

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3000 kw., 3 phase, 60 cycle, 600 volt, 3600 r.p.m. General Electric turbo generator unit.

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100 kw., 3 phase, 60 cycle, 2300 volt, 3600 r.p.m. General Electric turbo generator unit.

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750 kw., 3 phase, 60 cycle, 600 volt, 120 r.p.m. Allis-Chalmers generator to a Rice & Sargent 26x48x42 horizontal cross compound corliss engine, complete with Wheeler surface condenser. (Will reconnect for lower voltages).

150 kw., 3 phase, 60 cycle, 600 volt, 225 r.p.m. General Electric generator to a 4-valve Ball engine.

145 kva., 3 phase, 60 cycle, 220 volt, 257 r.p.m. Westinghouse generator to a 16x16 Erie Ball engine.

ANDREN-MYERSON CORP.,
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37½ K.V.A., 3 phase gen., 1200 R.P.M., 220 Volts, direct connected to Westinghouse turbine, condenser and switchboard.

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ALL TYPE ELECTRICAL INSTRUMENTS

WE BUY, SELL, RENT, REPAIR AND EXCHANGE all makes and type regulators and instruments. A large stock of rebuilt instruments on hand ready for immediate shipment. Priced low, write us your needs.

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A good used cradle type **ELECTRIC DYNAMOMETER** with maximum speed of 1500 R.P.M. and a minimum speed of 200 R.P.M. using two selective voltages namely 110 and 220 volts D.C. The capacity at 1200 R.P.M. should be approximately 75 hp. but not more.

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Pumps, Motors, Generators, M. G. Sets, Transformers, Compressors, Rotary Converters, etc.

Wire or Write

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1—150-300 K.W.—D.C.—250 Volt Generator Direct connected to High Speed Automatic Steam Engine.

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275-375 kva., 3 ph., 60 cy., 230 v; must be compact, good condition; give complete description.

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AIR COMPRESSOR

Sullivan tandem compound Air Compressor, steam driven, 2000 feet per minute, 100 pounds pressure. With complete equipment. Excellent condition.

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WANTED

1—75 to 100 kw. **Uniflow or four-valve engine generating set,** 220 volts, 3 phase, 60 cycles.

1—60 to 70 kw. **Diesel generating set,** 220 volts, 3 phase, 60 cycles.

1—50 kw. **Diesel generating set,** 220 volts, 3 phase, 60 cycles.

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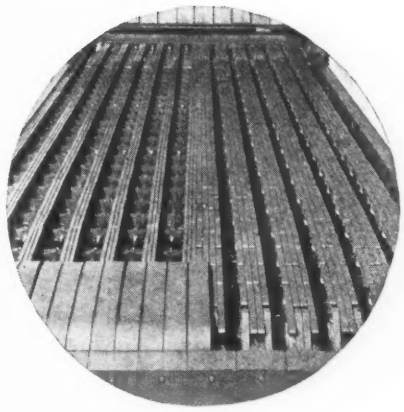
Don't Forget the Box Number

WHEN answering the classified advertisements in this magazine, don't forget to put the box number on your envelope. It's our only means of identifying the advertisement you are answering.

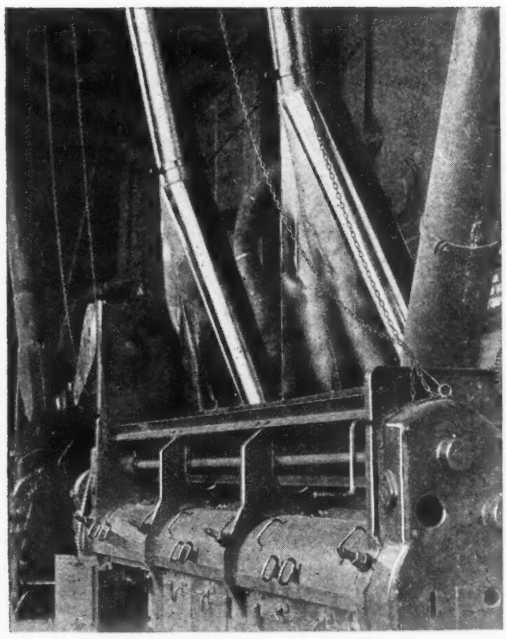
What is this?

Partially dismantled view clearly showing how moving chains (shown at right only) alternate with stationary grates (shown at left only). 34% of the grate surface does not move, thus insuring a uniformly thick and closely compressed fuel bed to the very end of the grate. The result of the retarding effect of the stationary tuyeres and rear cover plates.



The Stoker Built for a Perfect Fire

. . . . . *The* STOWE STOKER . . . . .



As burning progresses, a fuel bed shrinks in volume. If some means is not provided for compacting it, holes and fissures occur in the fire which seriously impair efficiency.

Exceptional Economy of Stowe Stokers is due primarily to the design described above which takes care of this compacting job.

This design also permits perfect air seal, a further economy.

Adequate support for moving mechanism, structural strength needed to avoid maintenance are other values which flow from this design.

Let us show you some of the records of economy which the Stowe Stoker has made.

The Johnston *and* Jennings Co.

CLEVELAND . . . . . OHIO

WE ASKED THE MEN WHO OPERATE THEM

●

We recently compiled and sent to users of De La Vergne Diesel Engines an eighteen page questionnaire covering almost every phase of performance and maintenance. To date we have received replies from a large number of users.

Typical of the answers received are the following abstracts:

The City of New Castle, Indiana, operates three Type VA engines, two 750 B. H. P. and one 500 B. H. P. units. With a running plant capacity factor of approximately 25%, the fuel consumption averages 11.22 K. W. per gallon. These engines have a total of 16 cylinders and the maintenance cost to date as reported by the City is a total of $14.80 in spare parts ordered from De La Vergne. One 750 B.H.P. and one 500 B.H.P. unit have been in service two years and eight months.

The City of St. Francis, Kansas, has operated a type VA engine for a period of six years and reports using to date parts costing a total of 50c in addition to some minor parts which were included as regular spares originally furnished with the engine.

The City of Russell, Kansas, has operated one 550 B. H. P. VA engine since November 1929 and reports having used parts which, at present day selling price, amount to $392.00. An 8 cylinder, 1000 B. H. P. unit of the same type was placed in service in this plant in September 1934.

Such records demonstrate why De La Vergne Engines are preferred for heavy duty, continuous service by men who know their Diesels.

●

DE LA VERGNE ENGINE CO.

Sales Agent for Baldwin-Southwark Corp.

PHILADELPHIA

DE LA VERGNE DIESEL ENGINES

"Ask the man who operates one!"

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"ALWAYS ON THE MOVE"

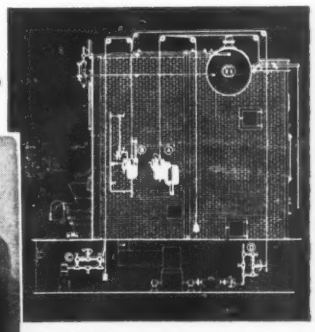
- - that's the A-Jacks

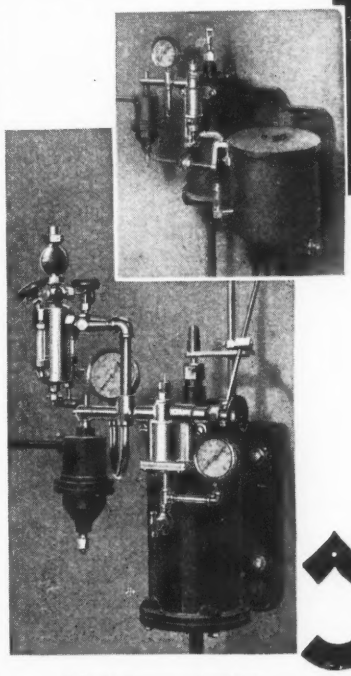
WATCH the uptake damper in a boiler furnace equipped with A-Jacks Combustion Control. While other controls would be standing still the A-Jacks is working—finding the right position to *keep* steam pressure or over-fire pressure right—hurrying on to the next position—always working—watching everything.

A good combustion control *must* do just that. Steam demands are fluctuating constantly—puffy winds and eddies are constantly affecting draft—only a highly sensitive, quick acting, powerful regulator can keep up with these ever changing conditions. Thousands of installations have proved that A-Jacks Combustion Controls can and do. As many operating records tell the story of this better control in plain terms of fuel saved.

The A-Jacks Damper Regulator and the A-Jacks over-fire control installed as shown below and made still more effective by the use of National Cam Valves, have a remarkable record in stoker fired plants. The A-Jacks is just as effective in smaller installations as in larger plants. Ask for complete information covering design, application, and performance.

National Regulator Co.
2315 Knox Ave. Chicago
Representatives in Principal Cities





A-Jacks Over-Fire Control (opposite)—used to control up-take damper, compensating for over-fire pressures produced by varying coal feed or induced draft. A typical hook-up of the A-Jacks Regulator and Over-Fire Control is shown in the diagram above. This is merely one of many effective hook-ups.

A-Jacks Damper Regulator —used in connection with highly accurate National Cam Valves to proportion stoker and blower speeds to steam demand. Operated on boiler pressure.

A-JACKS CONTROL

"the Control that watches everything"

A vast reservoir of EXPERIENCE!

YOU will probably never find a reservoir comparable in volume to the quantity of boiler feedwater which has been treated by the Nalco System and this quantity is growing enormously each year. This in itself is an impressive fact but it is made doubly so when you know that records have been kept . . . studies have been made . . . and results have been checked for practically every gallon of water so treated! Thus the actual water itself, from thousands of sources, has served in accumulating the vast reservoir of experience held in readiness to serve additional boiler plant operators who desire to capitalize on the Nalco System. *Perhaps you can profit by the experience of others. A Nalco survey of your plant will be made without obligation. Ask for it.*

NATIONAL ALUMINATE CORPORATION

6216 WEST 66th PLACE CHICAGO, ILLINOIS

Photo: Portland Cement Ass'n.